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COOPER HAWK
Painting by Allan Brooks

THE CONDOR

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ECOLOGIC RACES OF SONG SPARROWS IN THE SAN FRANCISCO BAY REGION

PART I. HABITAT AND ABUNDANCE

By JOE T. MARSHALL, JR.

The Song Sparrow, *Passerella* (*Melospiza*) *melodia,* is a characteristic inhabitant of vegetation growing in wet places throughout North America from Alaska and eastern Canada south to central Mexico. The territory of a pair of Song Sparrows is small, roughly two-thirds of an acre (Nice, 1943:152); accordingly, wherever Song Sparrows exist they occur in dense populations, with the pairs close together. The species is highly variable geographically; there are thirty geographic races, counting all well differentiated forms (thus omitting *mailliardi* and *santaecrucis* of California) in the A.O.U. Check-list and its supplements (American Ornithologists' Union Committee, 1931:357-361; 1945:449) and adding three more from Mexico (Hellmayr, 1938:607-608).

The races in the northern and eastern parts of the range occupy large areas and are migratory, or at least partly so, in that individual migration occurs (Nice, 1937:29-42). On the west coast, the races in the Aleutians and along the coast of California, the race in the central valley of California, and all races farther south are considered highly sedentary, and they occupy smaller areas. There are eleven races breeding in California alone. Three of these are restricted to islands off the coast. Throughout the entire range of the species no two geographic races are known simultaneously to occupy an area when they are in breeding condition.

All races except one, to my knowledge, live in a niche characteristic for the whole species, consisting of vegetation of a certain configuration and spacing on moist ground along the edges of streams, sloughs and coastlines. This niche will be defined later on the basis of the totality of attributes shared in common by the subniches, which I shall call "habitats," occupied by Song Sparrows in the San Francisco Bay region. An exception is the habitat of the race on the Los Coronados Islands, Lower California, where according to Grinnell and Daggett (1903:34) there is no trace of fresh water and the birds occupy the sparse growth of shrubs on shaded northeast slopes.

Most of the races occupy the several habitats, such as stream-side vegetation and salt marsh, wherever they exist within the range of the race. However, on the eastern seaboard, *Passerella melodia atlantica* is limited to salt marshes along the coast and is morphologically distinct from its relative *P. m. euphonia* in the adjacent inland freshwater habitats (Wetmore, 1936 and 1941:529). In the San Francisco Bay region the spatial isolation of different habitats, particularly bay salt-marsh from upland freshwater growth, is correlated with a marked differentiation of very local races, no less than four of which exist in the counties surrounding the San Francisco, San Pablo and Suisun bays (fig. 42). These counties, exclusive of the Sacramento-San Joaquin river drainage to the east of Suisun Bay, constitute the area to which this study is limited.

The four races of the "bay region" are characterized by their possession of broader and more distinct black streaks in the plumage than in other races of *Passerella melodia*. Of these, the race *gouldii* of the upland fresh-water habitats is most like Song Sparrows elsewhere along the coast of California; it is, in fact, merely a series of populations falling in an intermediate position on a coastal gradient for reddish-brown dorsal "ground color" (the color prevailing over the dorsal surface excluding the black shaft streaks) which has its maximum development in the extremely reddish-brown race, *cleonensis*, to the north. It is worthy of a subspecific name because it is the most reddish-brown race which possesses in addition black shaft streaks. The other three races are confined to bay marshes. *P. m. samuelis*, of the salt marshes around San Pablo Bay, is blacker in ground color than any other Song Sparrow race. *Pusillula*, of the salt marshes around the border of San Francisco Bay, is one of the smallest races (in dimensions of bill, wing and tarsus); also, it is one of the lightest in dorsal ground color and is the only race of the species which possesses yellow coloration over the entire ventral surface. *Maxillaris*, of the Suisun Bay brackish marshes, is the darkest of all the Song Sparrows. Not only does it possess a great deal of black in the plumage, as in *samuelis*, but in addition the reddish-brown and yellow pigments are very heavy on the dorsal surface, the black streaks wider than in any other race, and the overall ground coloration is intense rich blackish-brown. *Maxillaris* is of larger size than the other three races and possesses by far the thickest bill of any race in the species. The sides of the maxilla are, in fact, swollen and bulged out laterally, hence the subspecific name. In bill depth, it averages 28 per cent larger than *pusillula*.

These San Francisco Bay region Song Sparrows are often mentioned in the ornithological literature dealing with the origin of species. Huxley (1942:272) cites them as "a case of ecotopic subspeciation in birds where the two forms are kept separate by their ecological preferences." Miller and McCabe (1935:145) regard the ecologic versatility of Song Sparrows as contributing to their racial differentiation. Miller (1947) suggests that non-adaptive variation, correlated with a small effective population size, is responsible for some of the local differentiation of Song Sparrows; and Mayr (1942:249) correctly (in my opinion) states that spatial isolation has probably been a necessary prelude to their present ecological differentiation. Grinnell (1913:194) maintains that there must be "a strong preferment on the part of individuals for the fresh-water conditions on the one hand or the salt-water on the other," which serves as an isolating mechanism in places where the two situations are confluent. The foregoing statements in the ornithological literature are of course based on data published in the brief original descriptions of these races, especially of those described by Grinnell. He has summarized accurately, but in general terms, the ecologic, distributional and morphologic facts for all the "bay region" Song Sparrows in two short taxonomic notices (Grinnell, 1901 and 1909).

The purpose of my study is to furnish more complete information than is present in Grinnell's two papers on the habitat requirements, spatial isolation and morphologic attributes not only of the four races but of the several populations into which each race is subdivided by geographic barriers. This will facilitate an evaluation of the various factors which restrict free interbreeding between populations, thus preventing the obliteration of the racial differences. Because of the limiting of my method to field observations on habitat occurrence, censuses of individuals, and the examination of museum study skins, the factors considered will be mainly habitat restriction and geographic isolation. At least we shall see to what extent the boundaries of visibly distinct populations coincide with the boundaries between different habitats and with the limits of geographic barriers. Thus, the paper cannot furnish a final answer to the question of how geographic races arise and are perpetuated. That problem requires for its solution

(not to mention breeding experiments) knowledge of the seasonal and yearly movements, if any, of individual birds and particularly the extent of such movements across habitat and geographic barriers, in addition to a determination of the distance from the nest at which young birds settle down eventually to breed, all of which can be studied only by marking individuals on a large scale. The substance of this paper might furnish a necessary foundation for such studies.

Only the portion of this study dealing with ecology of Song Sparrows is included in the present article. The rest, concerned with an analysis of geographic variation, the coincidence of changes in gradients of geographically variable characters with certain zones of transition from bay marsh to fresh-water types of habitat and an attempt at interpreting this situation in terms of isolating mechanisms is scheduled for a later issue of The Condor.

The materials upon which the present ecologic portion is based consist of my censuses of Song Sparrows in the various habitats and my identifications of plants and of items in the stomach contents. For information concerning the unique ecologic situation at Palo Alto, from 1896 to 1908, I have consulted the field notes of Joseph Grinnell and Joseph S. Dixon, which are filed at the Museum of Vertebrate Zoology. Also, I rely upon correspondence with early observers at Palo Alto, whose kindness in replying to my questions I greatly appreciate. They are the following: John C. Brown, Joseph S. Dixon, Walter K. Fisher, Theodore J. Hoover, J. R. Pemberton and Robert E. Snodgrass. I am also indebted to William Longhurst, who piloted me around the bay region on a habitat inspection from the air and took me through the Napa River marshes in his scull boat. John E. Kesseli permitted me to examine his aerial photographs of Contra Costa County, and Emerson A. Stoner introduced me to the Suisun marsh area.

Joseph Grinnell's interest in this problem began in the period from 1900 to 1902 when he collected Song Sparrows in the salt marsh and an adjacent willow patch at the mouth of San Francisquito Creek, Palo Alto. He kept complete information in his field notebooks on the habitat occurrence of the individual specimens and called attention to the striking racial difference between the birds of the willow patch and the salt marsh (Grinnell, 1901).

From at least 1900 to 1908, there existed at the mouth of San Francisquito Creek an alluvium of several acres clothed with willows and containing about a dozen pairs of Song Sparrows distributed along its edge. The steepness of the alluvium brought about an abrupt change in habitat from willow growth to the surrounding *Salicornia-Grindelia* salt marsh, along a line several hundred yards long. Throughout this period the creek was populated with Song Sparrows for its entire length from the willow patch westward into the hills, and from there it was continuous with the upland population of the peninsula.

An examination of Grinnell's specimens taken beteen 1900 and 1902 reveals that interbreeding was definitely restricted between these representatives of two populations "a stone's throw" from each other. All but five of the twenty-six willow-patch birds are identical with specimens taken elsewhere in the uplands of the San Francisco peninsula; they have a brown back, white belly and large wing, tarsus and bill, whereas most of the twenty-eight salt marsh specimens are yellowish-gray on the back, yellow below and of small size. They are identical with specimens taken elsewhere in the salt marshes from Palo Alto north to San Bruno. The presence of one yellowish-gray and four yellowish-brown backs, and two yellow bellies in the willow patch series indicates that interbreeding must have taken place, although on a very small scale. A small collection taken by Dixon in 1908 reveals lack of mixing of the two racial populations equal to that in 1900-1902. The willow patch has since been obliterated and it is no longer possible to

study a similar situation at any point around the bay where races are well distinguished from each other morphologically. Grinnell (1901) suggested that the two races were behaving as incipient species at this habitat junction. With this in mind let us consider the habitat preference of the birds throughout the rest of the bay region, and especially their behavior at other junctions between habitats.

METHOD

Eighty-nine days were spent in the field and for each locality visited there was recorded the habitat, plant species, numbers of birds, their behavior and relations with other species. Where specimens were collected I have in addition recorded the plant association in which each specimen was taken, identified the stomach contents (of 233 birds collected in the fall) so far as hand lens will permit, and in critical areas have plotted each specimen on a map and identified members of breeding pairs. Fifty-four censuses (of birds not collected) were made in 36 localities during 37 days of the nesting season of 1947, March 29 to June 28. Each census record consists of a map, usually covering one to four miles along a habitat, with the vegetation identified and sketched in, and each Song Sparrow represented by a symbol. In critical areas I have added for each bird any outstanding morphological characteristics which could be discerned at close range with 6-power binoculars. All this is recorded in the field.

Preliminary intensive study for ten days at San Pablo revealed (as was confirmed by all subsequent observations) that pairs occupy territories arranged end-to-end in linear sequence, and always in single file. This is a consequence of the fact that the Song Sparrow habitats consist of narrow fringes of vegetation bounded on both sides by unfavorable habitat, whether it be the open water of a wide river or slough, or dry grassland adjoining the willow growth along a stream. Accordingly, most of the birds can be flushed by walking along a stream or slough bank, and it is therefore not necessary to map territories in order to count the birds. They flush at 10 or 15 yards, and those in likely-looking vegetation off the line of march can be attracted to a conspicuous perch or at least made to call loudly if the observed merely makes a squeaking sound, which to the Song Sparrow seems irresistable. A singing male, or two silent birds flushed together in an area in which no male is singing at the moment, I regard as representing pairs; a scale is furnished with the map so that the average distance between pairs can be computed in yards.

In particularly dense populations, ten or more pairs of birds within hearing distance of each other engage in universal singing or loud calling at times of particularly intense singing, fighting or alarm on the part of any one bird or pair. At such times they can be counted and thus a check is made of the census. Also I usually repeat each census hastily on the return trip. Not only does a carefully made census tally with a hasty return count, repeats on different days and times of day, and with numbers heard in periods of universal singing or calling, but it also agrees with censuses made along comparable habitats elsewhere. Therefore, it is felt that this census method yields a fairly accurate count in the nesting season.

GEOGRAPHY

The terrain of the "bay region" is mostly hilly; the only extensive flat areas border the three bays in a strip two to five miles wide, interrupted by hills reaching the bay shore at San Pablo Strait, Black Point, Carquinez Strait, South San Francisco and the Golden Gate. At the north side of San Pablo Bay, the Napa Valley constitutes an extension of the bay-side plain as far north as St. Helena; similarly at the south end of San Francisco Bay, the broad, flat valley of Coyote Creek extends far southward. These

plains peripheral to the three bays are of great importance in the distribution of Song Sparrows because they slope so gradually into the water that vast expanses of marsh vegetation can exist there. The hill systems consist of two parallel north-south chains, one along the coast, which is interrupted by the Golden Gate, the other along the east side of the Napa Valley, San Pablo and San Francisco bays, which is interrupted only at Carquinez Strait. The Pacific Ocean shore is mostly rugged and precipitous. It is irregular and cut by deep gorges so that north- and south-facing hill slopes alternate all along its length. Only at Bolinas Bay, Drakes Bay and Tomales Bay is the coastline relieved by estuaries which sufficient low-lying flat land to allow for the development of salt marshes.

CLIMATE

The climate of the San Francisco Bay region is cool and humid and because of proximity to the ocean is sufficiently uniform the year around so that the places inhabited by Song Sparrows differ little in the appearance of the vegetation through the seasons. The humidity allows the persistence of moist conditions the year around, except on the east slopes of the ranges, where the creeks dry up in summer. The source of moisture is rain clouds and fog which move toward the coast from the ocean and are caught by the ranges of hills. Accordingly the slope of the coast ranges rising from and facing the ocean shore is the most humid and has the most numerous streams, most of which are permanent. All north-facing hillsides there are moist enough to support Song Sparrows independently of actual riparian habitats. Fewer fog masses pass inland over the first range of hills, resulting in much drier conditions, particularly on the east slopes of hills and on the plains bordering the three bays. Thus the east side of the coastal range of hills is drier, with fewer streams than the side facing the ocean. The next rank of hills (bordering the east side of the San Francisco and San Pablo bays) is dry on its west slope except for an area directly east of the Golden Gate, where fog and clouds escape the dragnet of coastal hills and move across the bay to provide conditions moist enough for Song Sparrows on north-facing hillsides in Berkeley and Oakland. The east slopes of these hills and the territory beyond is still drier and much warmer than the east side of the coastal hills, and here one finds very few streams, few of which are permanent. Because of lower temperature and increase in humidity toward the north, moist conditions occur much farther inland in the northern part of the "bay region" than in the south. The most important influence of climate upon the distribution of Song Sparrows is the aridity of the plains surrounding the three bays. They are covered mostly with dry grassland, which constitutes a barrier between bay marsh Song Sparrows and those living in the adjacent uplands.

SALINITY OF THE BAYS

The major source of salt water for the three bays is, of course, the tidal flow through the Golden Gate from the ocean. Judging from the marsh vegetation, the saltiest bay is San Francisco, because the climate around it is hotter and drier so that only a few small streams enter it. There is little addition of fresh water, and evaporation concentrates the salt still more. Such streams as do reach this bay are too small and too steep to produce a zone of brackish water at their mouths. At low tide they contain running fresh water, at high tide salt water.

San Pablo Bay is salty, but less so than San Francisco Bay because it receives a large amount of fresh water from the San Joaquin and Sacramento rivers via Carquinez Strait. In addition it receives large rivers which drain the humid land to the north. The beds of these rivers (Petaluma Creek, Sonoma Creek, the Napa River) are more gradually sloping, broader, and contain more water than those emptying into San Francisco

Bay; accordingly they produce at their mouths a broad zone of brackish water which becomes slightly less salty in the rainy season but does not vary much with the tides.

Suisun Bay receives salt water from the tides which flow eastward through Carquinez Strait and fresh water from the Sacramento-San Joaquin River. It is entirely brackish, judging from the uniformity of its marsh vegetation.

HABITATS

Fresh-water marsh.—The vegetation of fresh-water marshes consists of *Typha latifolia* and *Scirpus californicus*. A marsh may have only one or the other species, or may have both in alternating pure patches. The configuration of vegetation (fig. 40*a*) is a mass of parallel vertical stems five to ten feet high, the individual stems being about two inches apart but deployed in clumps in such a way that at the ground level almost any point can be reached by a sparrow via six-inch wide passages. *Typha* growth provides more shade than *Scirpus* because of the several leaves ascending from each stem. Usually these plants grow in patches ten to twenty yards in diameter, and each growth is highest in the center, tapering off toward the circumference. Dense piles of dead prostrate stems of the previous year's growth are constant features. Between patches, or at the dry margin of the marsh, and at the bases of the stems not covered with water is bare cracked mud or wet ooze. The vegetation ceases at the dry margin of the marsh and in deep water. It can persist, because of its perennial rhizomes in places where the water dries up for part of the year.

There are several small fresh-water marshes near the coast, especially along the peninsula from Lake Merced south to Tunitas Creek and along the San Andreas fault. Others occur near the mouth of the Napa River and there was once a vast marsh at the mouth of Walnut Creek, Contra Costa County, which is no longer in existence. Otherwise, in the interior, these marshes exist only at artificial lakes. The total area of fresh-water marshes is slight compared to other Song Sparrow habitats. Near the coast, they are connected to soft chaparral where bounded by humid, north-facing slopes, and to the riparian habitat where streams enter them. Inland, they are usually surrounded by dry grassland and their only connection with other Song Sparrow habitats is a narrow one at the stream entrance. However, there is always some connection between fresh-water marshes and other Song Sparrow habitats, whether they be riparian, soft chaparral or brackish marsh. There is generally a gradual change in habitat at the connections, and in all cases the sparrows show no preference for one or the other habitat and form a continuous population across such boundaries.

I have no counts of pairs in fresh-water habitats, but my impression is that the birds are as abundant there as in brackish or salt marshes of similar vegetational configuration. This growth always constitutes a narrow band of vegetation whose width is greater, the more gradually sloping the shore of the pond concerned. There is never more than a single row of pairs in this band, and I should guess that pairs are about 30 yards apart where the width is forty yards, and about 80 yards apart where it is 10-15 yards.

Song Sparrows sing from the highest stems in the center of patches of vegetation, hide in the dense piles of prostrate stems and forage on the mud at the base of the stems or on the lake margin, obtaining their food of seeds and small insects. I have never seen them eating seeds from the plants themselves; apparently they must wait for them to fall to the ground. However, I once saw an individual climbing the stems of *Scirpus californicus* like a nuthatch, picking off tiny insects.

Song Sparrows are less tolerant of drying than *Typha* and *Scirpus californicus* and are further limited within the most permanently moist marshes to the portions where bare ground is available for foraging. Thus, the distribution of the birds is much more

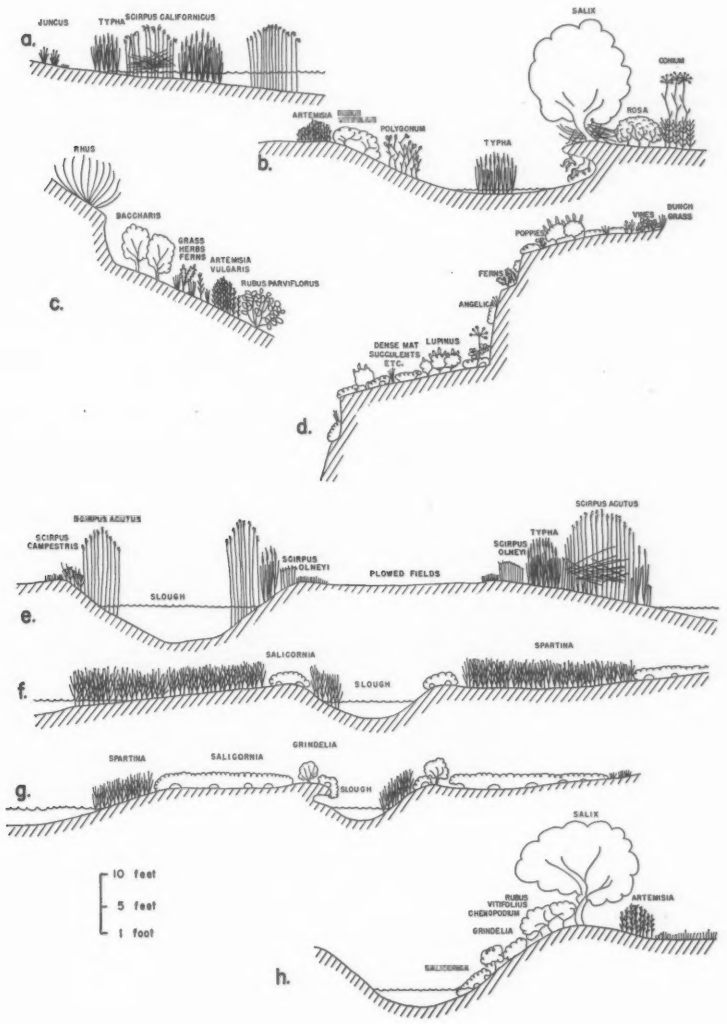

Fig. 40. Song Sparrow habitats in diagrammatic cross-section: (a) *fresh-water marsh,* mouth of Olema Creek, Marin County; (b) *riparian,* San Leandro Creek, Alameda County; (c) *soft chaparral,* Strawberry Canyon, Alameda County; (d) *seaside chaparral,* Point Reyes, Marin County; (e) *brackish marsh,* Grizzly Island, Solano County; (f) *Spartina marsh,* San Pablo, Contra Costa County; (g) *Salicornia-Grindelia marsh,* Corte Madera, Marin County; (h) intermediate zone at mouth of Guadalupe River, Santa Clara County.

circumscribed than the distribution of the vegetation. Further, the birds are absent from fresh-water marshes where the growth is sparse, with stems a foot or so apart; such growth offers no concealment.

Marsh Wrens, Yellow-throats and Red-winged Blackbirds are fairly constant associates of the Song Sparrow in fresh-water marshes, but the only birds which have somewhat similar foraging requirements are, in winter, the Lincoln Sparrow and the Savannah Sparrow. These birds are seldom found in the actual marsh vegetation and forage mostly in moist grassland around the edges of the marsh. The Song Sparrow is the most abundant and most characteristic avian inhabitant and probably has no effective competitors for food, nesting sites, song perches and hiding-places among the other birds.

Stream and river margins.—Willow trees are the characteristic and predominant growth along streams, but smaller plants, *Rubus vitifolius*, *Rosa californica* and *Artemisia vulgaris*, are constantly associated with them. In addition, other trees, in order of their frequency, are often associated with the willow: *Acer negundo*, *Aesculus californica*, *Populus fremontii*, *Fraxinus oregona* and *Acer macrophyllum*; and the following plants may add to the low growth: *Conium maculatum*, *Polygonum acer*, *Urtica gracilis*, *Rumex crispus* and *Symphoricarpos albus*. *Typha latifolia* and *Scirpus californicus* occur in the stream itself where light is sufficient.

The configuration or growth form of this vegetation (fig. 40*b*) consists of the willow stems dividing into many branches at the ground level and ascending outward 10 to 25 feet to form a hemispherical crown. With closely-spaced trees these stems retain a loose pile of dead twigs on the ground, but under more open stands which are occasionally washed by the stream, the ground is bare or littered with dead leaves. Bare mud occurs at the water's edge and the root systems may be undercut by the stream, providing many dark labyrinths where Song Sparrows forage. Around the edges of the willows and between widely spaced trees grow the dense vine tangles of rose and blackberry and compact masses of the erect stems of *Artemisia* and *Polygonum* 3 to 5 feet high. These plants usually occur in alternating pure patches 5 to 15 yards long.

The limiting factors for this particular kind of riparian growth appear to be water and light. This vegetation disappears in canyons whose steep walls or coniferous timber shade the stream, and it is absent from streams with beds cut so low that the roots of the plants cannot reach water. However, it can persist along streams which are dry for part of the year. Riparian habitats are most prevalent near the coast, where every little gully on the north-facing slopes is lined with willows. Inland, streams become fewer, losing this type of riparian growth where they pass through heavy forests, but some provide continuous environment suitable for Song Sparrows through gaps in the hills, and they become more numerous again in the east bay hills opposite the Golden Gate. In the arid eastern part of the bay region, streams become fewer and are not permanent. Nevertheless, this habitat forms a vast branching network which connects all the other Song Sparrow habitats to each other and which provides the principal environment for upland Song Sparrows.

With two exceptions (mouth of San Francisquito Creek and mouth of Mill Creek, Marin County) riparian habitat grades smoothly through a zone of intermediate or mixed vegetation into all the other habitats and at no such zone have I observed any interruption in the linear continuity of Song Sparrow territories, nor any marked preference for one or the other habitat by birds in the intermediate zones. There is a marked difference in the form of this junction with salt marshes in San Francisco Bay as opposed to northern San Pablo Bay. There is no area of brackish water at the mouths of the small streams entering San Francisco Bay. Accordingly the salt-water vegetation extends upstream as far as the tides reach and grows low on the banks. The fresh-water

vegetation grows above it on the top of the bank and thins out toward the marsh. Thus, there is a zone several hundred yards long where the two habitats overlap (fig. 40*h*), and both are included in the territory of each pair of sparrows there. Neither habitat is wide enough to support Song Sparrows by itself. Sparrows are observed foraging in both types of vegetation, which is proven by the stomach contents; for instance, *Conium* seeds and snail shells are to be found in the same stomach. The large streams which enter northern San Pablo Bay form brackish marshes at their mouths, and the transition from riparian to salt vegetation is thus much more gradual.

Other factors being equal, the distance between pairs of Song Sparrows (that is, the density of the riparian population) along streams crossing the bayside plains depends on the width of the band of stream-side vegetation. Pairs are farther apart in narrow than wide zones of riparian vegetation. Most streams in the bay area have been banked off so that this growth is restricted to a 5- to 10-yard fringe on steep banks. Under natural conditions the vegetation may extend out 25 yards. Each Song Sparrow pair has the headquarters of its territory at the bank of the stream, so that there is never more than a single row of pairs along one bank. Triple rows are found only under natural conditions, such as the mouth of Walnut Creek, where there is a row of pairs along each bank of the main creek and a third row along an accessory creek 50 to 100 yards to the side. Pairs are 50 yards apart here, where the vegetation is about 25 yards wide.

At the Napa River (south side of Napa) the vegetation is only 5 to 15 yards wide but the river is broad (60 yards), and I saw no birds crossing it, even when chased around in their territories. Here we have two rows of territories, one row on each side of the river, with 60 yards between pairs. Sonoma Creek, at Glen Ellen, is only 3 or 4 yards wide and the vegetation grows out 10 to 20 yards on each side. Birds fly back and forth across the creek and we find a pair every 33 yards but in a staggered arrangement, permitting a telescoping of territories because of the wide habitat. At the mouth of San Pablo Creek, which is narrow, the growth is restricted to a 10-yard band on each bank, and a single file of pairs is found, one pair every 57 yards. In canyons, the riparian growth becomes more or less shaded out of existence by laurels and live oaks, and at Wildcat Canyon there is a pair only every 110 yards. At Miller Creek, with still more laurels, pairs are 280 yards apart, on the average. Song Sparrows sing from the upper parts of the willows, find concealment in the dense shrubbery and usually forage on the ground. (I once saw some birds feeding on caterpillars high in the willows.) In foraging, they hop rapidly over the mud of the stream margin and work under the patches of blackberry and *Artemisia*. They are particularly attracted to the piles of willow twigs and the dark recesses under the stream banks where they resemble Canyon Wrens in their activity, slipping among the roots in very dark crannies. Food consists mostly of seeds, although small insects are also taken.

The factors of moisture and light seem to exert more stringent limitations upon the Song Sparrow than upon the willow. Sparrows respond to dry conditions in the eastern part of the "bay region" by moving or possibly migrating in the fall. At Muir Woods, the general configuration of streamside vegetation is similar, both inside and outside of the redwoods. But Song Sparrows are very common (pair every 40 to 50 yards) downstream from the redwoods and are entirely absent from that part which is roofed over by the trees. (The last pair is just 50 yards inside the main entrance to the park.) Absence of the vine and shrub growth along streams is another serious limitation to Song Sparrows. Places such as Huichica Creek, Napa County, where all this growth is grazed and trampled by cattle, are devoid of Song Sparrows. Even the willow itself limits sparrows when it grows in a continuous dense canopy. At the south end of Lake

Merced, San Francisco, there is a veritable "woodland" of dense tall willow growth, the dark interior of which is avoided by the birds.

Song Sparrows are the most abundant and characteristic avian inhabitants of riparian habitat, at least along streams crossing the bayside plains. They have the habitat pretty much to themselves and so do not have competitors with similar requirements at least in summer. In winter, riparian growth is shared with winter visitant races of Song Sparrows, White-crowned Sparrows and Lincoln Sparrows. However, the Lincoln Sparrows prefer moist grassland or more open weed growth away from the willows, the White-crowns and *Passerella m. fisherella* forage in drier brush and weeds near the stream, and *Passerella m. morphna* is thus the only form which competes with the local race for food, but it is outnumbered about 10 to 1.

Soft chaparral.—Baccharis pilularis, Rubus parviflorus, Rubus vitifolius, Rhus diversiloba, Conium maculatum, Heracleum lanatum and *Artemisia vulgaris* are but a few of the multitude of plants, including ferns, grasses and sedges, which compose the soft chaparral. These plants tend to form a continuous, dense cover 4 to 8 feet high, but Song Sparrows frequent them only in places where the growth is divided into small clumps of bushes and separate tangles of vines bordered by small grasses, ferns and flowers, and separated from each other by bare ground which is actually wet. In this form (fig. 40*c*) soft chaparral is limited by moisture conditions to north-facing slopes along the coast (but not within 100 yards of the ocean) and to those interior north-facing slopes which are near or east of the Golden Gate. Accordingly its distribution embraces only that part of the coastal hills where coniferous or oak-madrone woodland is absent, small patches along the southern border of Richardson Bay salt marsh and Corte Madera salt marsh in Marin County, the Richmond Hills, and the Berkeley Hills from two miles southeast of Redwood Peak to Wildcat Canyon.

Within 100 to 200 yards of the ocean, soft chaparral blends gradually into seaside chaparral, and it is penetrated by riparian habitat along every moist gully. Inland, it is invariably linked to riparian habitat, but only at Drake Bay, Richardson Bay and Corte Madera do we find it contiguous both with salt marshes and streamside growth. At Richmond Hills it is joined to the San Pablo Bay salt marsh. These junctions with salt marsh vegetation are of course abrupt, but do not involve a radical change in vegetational growth form; *Baccharis* grades into *Grindelia* and the low grasses and weeds into the *Salicornia* mat of the salt marsh. Song Sparrow territories there appear to include both habitats within their boundaries. Birds continually fly back and forth from *Salicornia* to poison oak thickets, and I have seen at Richardson Bay a female which repeatedly carried food from the salt marsh to its young in a nest in poison oak.

The abundance of Song Sparrows in soft chaparral depends upon the amount of "edge" and moisture provided. At Richmond Hills, where the *Baccharis* bushes are far apart and where the ground is so wet that there is a growth of *Juncus*, pairs average 50 yards apart. At Frank Valley, Marin County, pairs average 87 yards apart; the drier Montara Mountains, San Mateo County, have pairs 200 yards apart; and at Strawberry Canyon, Alameda County, pairs are separated by 225 yards, occurring only where the continuous cover of vegetation is broken by steep gullies or slides. (*Conium maculatum* in Strawberry and Wildcat canyons forms pure stands in which a singing male can be found every 25 yards.)

Song Sparrows utilize the dense tangle of vegetation for concealment, sing from the tops of the highest bushes, and forage almost exclusively on the bare ground under and around the edges of the clumps of bushes for their food of seeds and small insects. Light is a limiting factor which seems to work directly on the birds, for they are absent from chaparral which forms a continuous high canopy and from that portion of the soft

chaparral, even though it is composed of the same species, which penetrates woodland and there forms the understory vegetation. Only at the summit of Inverness Ridge, Marin County, and Redwood Peak, Alameda County, are there any Song Sparrows in patches of soft chaparral within the forest; in both these places the trees (bishop pine and redwood, respectively) are small and widely spaced and the sparrows are found only in the widest clearings. Elsewhere, for instance along the Tunitas Creek and Kings Mountain roads in San Mateo County, they are totally absent even from the wide clearings, moist swales, and poison-oak thickets both in the redwood forest and the oak-madrone forest.

White-crowned Sparrows share this habitat with the Song Sparrow only at the Richmond Hills and close to the sea coast. Their interrelations will be discussed under the next habitat, seaside chaparral.

Seaside chaparral.—On the north slope of Point Reyes there is a band of vegetation growing between the edge of the cliff and the 500-foot contour in exceedingly moist conditions resulting from almost constant fog and a high rainfall. The ground is everywhere wet, although there is no standing water. Predominant plants are hemispherical shrubs of *Lupinus arboreus* 2 to 4 feet high, growing in short rows with stems three feet apart or as solitary bushes nine feet apart. The ground between the lupines is densely clothed with a mat a foot or more high of succulents, grasses, vines, flowers and ferns (fig. 40*d*). Some of the plants which contribute to this mat are *Eriogonum nudum, Echinocystis fabacea, Pteridium aquilinum, Orthocarpus,* a small *Rubus, Eschscholtzia californica, Grindelia robusta, Ligusticum apiodorum* and various grasses. Other solitary plants, such as *Angelica hendersonii* (22 inches) and a bunch grass (12 inches) stand by themselves or extend above the general level of the turf and *Achillea millefolium* and *Stachys californica* recline against or grow up through the lupine. There is space under the lupines where Song Sparrows can forage on bare ground; also, the vegetational mat is permeated by channels made by rainwater and perhaps small mammals. Rocks, steep bare banks and cliffs divide the vegetation into patches so that plenty of "edges" are provided for foraging. There is room in this seaside chaparral habitat for a single or staggered row of Song Sparrow territories, and a pair is found every 43 yards.

A little patch of seaside chaparral is found at Montara Point, San Mateo County. Here the configuration of vegetation is a solid mat two feet tall, bounded by rocks and steep banks. The predominant plants are *Eriophyllum staechadifolium,* prostrate *Baccharis pilularis, Angelica hendersonii, Ericameria ericoides, Castilleia, Rubus, Equisetum, Juncus* and several kinds of grass. Song Sparrow pairs here are 30 yards apart, all within 50 yards of the beach. At the mouth of Tunitas Creek, San Mateo County, pairs are 150 yards apart because the shoreline faces west and the patches of *Eriophyllum staechadifolium* (4 to 5 feet tall) and their associates (*Eriogonum, Heracleum, Rubus vitifolius* and *Chlorogalum*) are restricted to the north-facing sides of gullies which must alternate with drier exposures. Pairs here are within 25 yards of the ocean.

Seaside chaparral is limited apparently by its demands for constant moisture (short of standing water) to north-facing slopes within 100 yards of the ocean. It is bounded by the steep bank or cliffs at the shore and is lost inland where grassland or drier chaparral begins. Its distribution in the bay region consists of patches at the mouth of Tunitas Creek, Montara Point, a belt along the ocean base of Montara Mountain, a continuous belt around the north end of the San Francisco peninsula from Point Lobos east to the Golden Gate Bridge, along the coast of southern Marin County, Point Reyes, and from Tomales Point to the Russian River. In a few places it grades gradually into soft chaparral, but it is mostly connected to other Song Sparrow habitats by willow

growth along streams which reach the coast. In such places the birds form continuous breeding series across the habitat boundaries.

Song Sparrows utilize the tops of the lupine bushes for song perches and can find concealment anywhere in the vegetation. They forage on the ground under the lupines and along the mammal trails and other passageways under the low dense growth. They also feed among rocks and in each tiny patch of vegetation clinging to the steepest cliffs. Thus, they must expend much energy flying vertically, to say nothing of countering the constant strong winds which buffet them. Food consists mostly of seeds of *Eriophyllum*.

There is no discernible limitation restricting the birds to any portion of seaside chaparral, and the range of the sparrow coincides with that of the vegetation. They are totally absent from grazed areas on the Point Reyes peninsula, where the mat of succulent vegetation between the lupines is lacking and where White-crowned Sparrows persist. At Point Reyes, the seaside chaparral is interdigitated with grassland, which becomes predominant on the top of this headland. Thus, the Savannah Sparrow is brought into close contact with the Song Sparrow and the two can be found singing, foraging and hiding in identical situations, although the Savannah Sparrow appears not to forage under vegetation. They do not affect each other, as each Savannah Sparrow has a very large forage area most of which is in the grassland.

The resident race of White-crowned Sparrow, *Zonotrichia leucophrys nuttalli*, comes into closer association with Song Sparrows than does *Passerculus*. In all seaside chaparral and on the very wet north-facing slopes of the Richmond Hills, the two species occupy common ground, and in equal numbers. Cursory observations reveal no territorial accommodation one for the other, so that we find for the Song Sparrow at least, normal-sized territories bordering upon each other in continuous chains, with the territories of White-crowns seemingly superimposed upon them. The two species pay no attention to each other, nor does it appear that they compete in any way for food or nesting or singing sites. It is my impression that although the White-crowned Sparrow forages on the ground under large bushes, it does not go under the mat of succulents; it also picks seeds from the upper portions of the plants.

Brackish marsh.—*Scirpus acutus* and *Typha latifolia* are the predominant plant species in brackish marshes. Associated with them are *Scirpus olneyi, Scirpus campestris* and *Scirpus californicus*. At the gradually sloping bay shore this growth is fairly homogeneous, consisting of a belt 100 to 200 yards wide of mixed *Typha* and *Scirpus olneyi* 6 to 8 feet high and widely spaced large patches of *Scirpus acutus* 8 to 12 feet high. Their stems are 4 to 6 inches apart. In addition, there are large patches of pure *Scirpus campestris* 2 to 3 feet high with stems 1 to 2 inches apart. On the steeper banks of large sloughs this growth is more zonal, with stands of pure *S. acutus* growing in deep water, either in a continuous belt or in patches 50 to 75 yards apart, followed by a fairly continuous band of *Typha* higher on the bank, then large masses of pure *S. olneyi* alternating with *S. campestris*. These plants, especially *S. acutus*, retain masses of dead stems of the previous year, sometimes in piles six feet high; there is exposed mud at the bases of the stems and along the slough margins. This habitat (fig. 40*e*) is limited to that portion of the land which is covered at high tide and drained by sloughs at low tide.

Brackish marsh is the prevailing habitat of Suisun Bay. Elsewhere, it occurs on the lower half of Southampton Bay, and in a zone bridging the gap between fresh and saltwater habitats along the Napa River (three miles long), Sonoma Creek (two miles long), Petaluma Creek (no longer connected to riparian growth) and at the head of Tomales Bay. The connection between brackish marsh and riparian habitat is very gradual because *Scirpus californicus* and *Typha* carry the growth form (identical with *Scirpus acutus*) far up-stream beyond the limit of tidal flow. Similarly, *Scirpus acutus*, with its

greater tolerance for salt, continues from the brackish zone far into the salt marsh area at the mouths of large rivers, so that it grades finally into *Spartina* stands of roughly equivalent growth form, as far as sparrows are concerned. There is no interruption of the linear sequence of breeding Song Sparrows through these transitions and the birds at any intermediate zone do not sort out into different plant associations. Song Sparrow pairs are about 48 yards apart along the broad band of vegetation at the bay shore and are separated by 52 to 70 yards along slough banks, depending upon the width of the fringe of plants (15 to 5 yards, respectively). They use the tallest *Scirpus acutus* in the centers of patches of that species for song and calling perches and find concealment in the piles of dead stems, where their presence is announced by continual rattling of the stems as the birds hop from one to another.

Foraging takes place on the bare surface of the ooze at the bases of stems and along the slough margin at low tide. They feed principally on *Scirpus* seeds, but take insects, especially mosquito larvae. Here these energetic birds pick the *Scirpus* seeds from the ground after they fall, to be carried away by each tide, while only six feet over their heads exists the vast untapped supply on the flowering stems. Song Sparrows are limited to the area covered by the tides, where the flow is unimpeded by man-made levees. The height of these levees has permitted the appearance of upland plants requiring fresh water; namely *Baccharis pilularis, Rosa californica* and some *Salix*; Song Sparrows do not avoid them, but their territorial headquarters are always at the slough margin.

In the fall, both adults and juveniles may wander over the levees to forage and even sing in the adjoining hayfields. Artificial levees in many parts of Suisun Bay have caused the development of salt marsh vegetation in low places which are flooded by extremely high tides, following which the salt is concentrated by evaporation. *Salicornia* and *Grindelia* grow in these areas, but they are consistently avoided by the sparrows. This is not because the birds are intolerant of salt vegetation but rather because the tidal flow is impeded and the water is stagnant and red in color. (The same condition is found even in the salt marshes of San Francisco Bay, where the birds avoid stagnant situations.) On the east side of Cordelia, Solano County, there is a little marsh which has a considerable expanse of pure *Salicornia* resulting from a restricted tidal flow through a railroad culvert. Nevertheless, the marsh is drained at low tide, has no stagnant water, and Song Sparrows utilize the *Salicornia* for foraging and sing there as if their territories included that vegetation in addition to the adjacent *Scirpus*. Therefore, it cannot be argued that Suisun Bay Song Sparrows are strictly intolerant of *Salicornia-Grindelia* growth. Of course, under natural conditions such vegetation is entirely lacking from their domain.

Within typical brackish marsh each pair is limited to a territory which contains a patch of *Scirpus acutus* standing above the surrounding vegetation. Apparently such high song perches are necessary for the birds, and their absence might constitute a limiting factor in Song Sparrow distribution. The birds generally avoid *Scirpus campestris* where it grows in low patches with closely packed stems.

Song Sparrows in brackish marshes are, as in most of the other habitats, the sole ground-foraging birds and the predominant avian species. Marsh Wrens, Yellow-throats and Red-winged Blackbirds are also prominant in brackish marshes, but the two former appear to forage mostly in the upper parts of the plants, and the Red-wings forage in adjacent fields, so that the Song Sparrow probably has no serious competition for food.

Salt-marsh.—Spartina foliosa, Salicornia ambigua and *Grindelia cuneifolia* compose the vegetation of salt marshes. (*Distichlis spicata* and *Frankenia grandifolia* are relatively inconspicuous associates of *Salicornia*. Occasionally they form little circular

patches with closely packed stems permitting no entrance for foraging by the birds.) These plants grow in successive altitudinal strata with *Spartina* lowest and *Grindelia* highest. Thus, in a marsh which slopes gradually into the bay we find (inland from the mud flats which are exposed only at low tides) first a broad zone of *Spartina*, whose stems are partly covered at high tide, then inland on higher ground, a broad zone of *Salicornia* which is covered only by the highest tides. Beyond the *Salicornia* comes grassland, which is above the high-tide mark, and we thus find no zone of *Grindelia* on the inner border of the marsh. *Grindelia* occurs on the elevated banks of sloughs in the *Salicornia* zone.

The belt of *Spartina* is traversed by straight sloughs with gradually sloping banks, too deep for vegetation to grow, and not emptied at low tide. The tops of the banks of these sloughs, under natural conditions, are higher than the surrounding *Spartina* marsh and have a band of *Salicornia* along them. Upon reaching the inner zone of *Salicornia*, the sloughs branch and begin to wind in intricate convolutions. They are shallow enough to permit the growth of *Spartina* in their beds, and the raised tops of the banks support a band of *Grindelia*. Because of the ability of the *Salicornia* to hold soil with its roots, the banks of sloughs in the *Salicornia* zone are deeply undercut. Accordingly the configuration of the habitat in the *Spartina* belt (fig. 40*f*) consists between sloughs of the continuous solid growth of vertical *Spartina* stems 2 to 4 inches apart and with mud at their bases exposed at low tide, giving way to a band six feet wide of *Salicornia* on the top of the slough banks (growing two feet high in the middle of the band), then *Spartina* again on the descending slope of the slough, below which a mud area is exposed at low tide.

For the *Salicornia* belt (fig. 40*g*), the growth between sloughs consists of a solid mass of radial *Salicornia* bushes 12 to 18 inches high and growing close together so that their branches interlock. This mat is permeated at the ground level by the runways of large *Microtus*, and other spaces between bushes at the ground level, apparently formed by a raising of the lateral branches of *Salicornia* with the tides. At the raised part of the slough bank grow *Grindelia* bushes of spherical shape, 3 to 4 feet high, either in chains or as individual plants, forming a belt 1 to 10 yards wide bordering each slough. At the very brink of the slough the *Salicornia* turf projects 1 to 3 feet out over the steep bank, and the bottom of the slough is choked with *Spartina*.

Old, high marshes lack the *Spartina* zone, and at such places as the mouth of Alviso Slough, the *Salicornia* growth ends at an abrupt six-foot bank fronting on the mud flats. In younger, low marshes, such as San Pablo Marsh, the *Spartina* zone is predominant, 400 yards wide, and *Grindelia* is just beginning to appear on some of the highest slough banks. At Pinole, the level of the marsh is raised so high that the *Spartina*, *Salicornia* and *Grindelia* zones are condensed at the steep bank facing the bay, interior to which grasses and weeds such as *Rumex* and *Chenopodium* are already gaining a foothold and suggesting the fate of all salt marshes which continue to rise without extending their boundaries farther out into the bay.

It can be seen, therefore, that the limiting factors affecting the salt-marsh vegetation are deep water (lacking wave action) and dry land, and the growth is thus limited to approximately the upper two-thirds of the intertidal zone. Its distribution includes all the bay marshes of San Francisco and San Pablo bays, the upper half of Southampton Bay marsh, the lower half of the marsh at Tomales Bay on the coast, and a small patch at Drakes Bay on the Point Reyes peninsula.

Song Sparrow pairs in *Spartina* portions of salt marshes are spaced at 76 yards along the edges of the sloughs, in single file along each bank. In the *Salicornia-Grindelia* portion pairs are 30 to 100 yards apart. They are closer together where the *Grindelia*

band is widest. In the *Spartina* type of marsh, Song Sparrows sing from the tallest *Spartina* stalks and feed on the mud either at the gradually sloping bank of the slough or among the *Spartina* stems, or in the *Salicornia* of the raised banks. Only at high tide do they forage more than 30 yards from the sloughs. Their food is mostly snails, small nereid polychaete worms, insects and other small invertebrates, but in fall they eat quantities of green *Spartina* flowers which they reach by alighting in the stems.

In *Salicornia-Grindelia* marsh the birds utilize the tops of the *Grindelia* bushes for song perches and find concealment under the vegetation or under the overhanging slough banks. When alarmed, they cannot reach the undercut slough bank without flying and so revealing themselves; however, they make the best of it by looping into the slough as fast and low as possible, then streaking off in headlong flight a few inches above the water to a point under the bank often 50 yards away, all the while admirably following the tortuous course of the slough.

They forage under the overhanging banks at low tide. The forage behavior here consists of very rapid progression by a smooth series of hops with head and tail held low, apparently when they are pursuing flying insects. At other times they progress more slowly and in jerky manner with head up, the tail constantly jerked upward at a high angle, and pick up objects from the mud. When foraging in the vegetation, they fly to the top of a *Grindelia* bush, hop down through it to the ground, then creep along through the mammal trails far out into the pure *Salicornia* mat. They progress exceedingly rapidly under the *Salicornia,* for it is possible, if the observer runs fast enough and in the right direction, to flush a sparrow 25 or 30 yards away from his *Grindelia* bush only a few seconds after it reached the ground level. The food consists of small nereids, snails and a variety of insects and other invertebrates. On one occasion I saw a bird feeding on *Grindelia* seeds in the manner of a finch, from the top of the flowering stalk; collected it and found carefully peeled *Grindelia* seeds in its stomach and bill. At Pinole, I collected a bird which had made several fly-catching flights from a fixed perch, a three-foot stake. It had an adult mosquito in its bill and another in its stomach.

Song Sparrows are limited by the height of the salt vegetation. At Alviso, they are absent from *Spartina* 18 inches or less in height and from a great area where the *Spartina* has from unknown causes been flattened. At another point where the *Spartina* is only 2 to 3 feet high, pairs are 100 yards apart. Song Sparrows are also absent from a broad belt of *Salicornia* growth less than a foot tall which is normally found on the highest portion of a marsh (inland), and which is occupied only by Savannah Sparrows. Territories invariably are restricted to a single row along one or both banks of the sloughs (depending on the width of the slough and the width of the *Grindelia* band bordering it). Song Sparrows are absent from all areas where the tidal flow is cut off by man-made dykes. Such places have vegetation similar to a natural marsh, but the water there is stagnant and foul.

In the inner parts of the marshes where the *Salicornia* growth becomes progressively lower, the ranges of the Song and Savannah sparrows overlap. Savannah Sparrows extend inland to and including moist grassland surrounding the marsh. Owing to the exceedingly long flights made by this species to forage ground, we find it at low tide feeding on slough banks well within the Song Sparrow's domain.

DISTRIBUTION OF HABITATS AND OF SONG SPARROW POPULATIONS

Figure 41 shows the distribution of the kinds of environment occupied by Song Sparrows in the Bay region. Of primary importance is the fact that under natural conditions each kind of habitat, wherever it exists, is at some point connected to another kind by a zone of intermediate vegetation forming a gradual transition between them

(except at San Francisquito Creek and Southampton Bay). Such zones of transition invariably involve a long row of Song Sparrow pairs at the opposite ends of which free interbreeding takes place with the birds of the respective divergent habitats. Figure 41 is of course equivalent to a map of the occurrence of Song Sparrows. Using the areas of

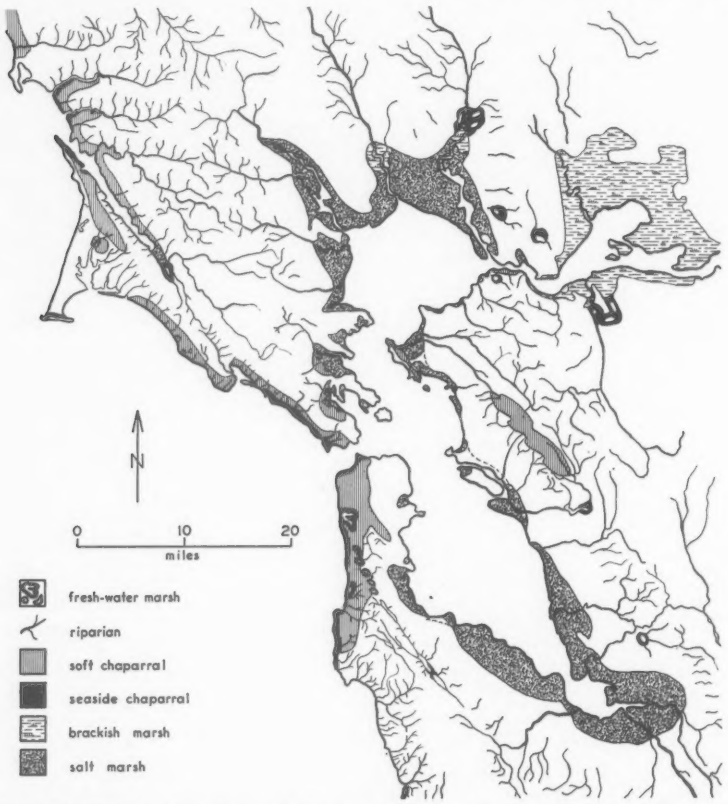

Fig. 41. Distribution of Song Sparrow habitats in the San Francisco Bay region. No attempt has been made to indicate the limitation of soft chaparral to each north-facing slope within the areas allotted to that habitat. The width of the seaside chaparral belt along the coast has been greatly exaggerated, to make it show on the map. The distribution of the bay marshes and the riparian avenues connecting them to the uplands follow U. S. G. S. maps made around 1900, and are intended to show the probable distribution of these habitats under natural conditions prior to the drastic reduction in their areas brought about by civilization.

absence or sparse occurrence of Song Sparrows as boundaries, we can divide the birds into populations as shown in figure 42. This reveals that the dense bay marsh populations are separated from each other by open water or by ranges of hills jutting into the bay and are separated from upland populations by the width of the arid bayside plain. In the uplands we find sparse populations which become denser toward the coast, consisting mostly of single rows of pairs along streams.

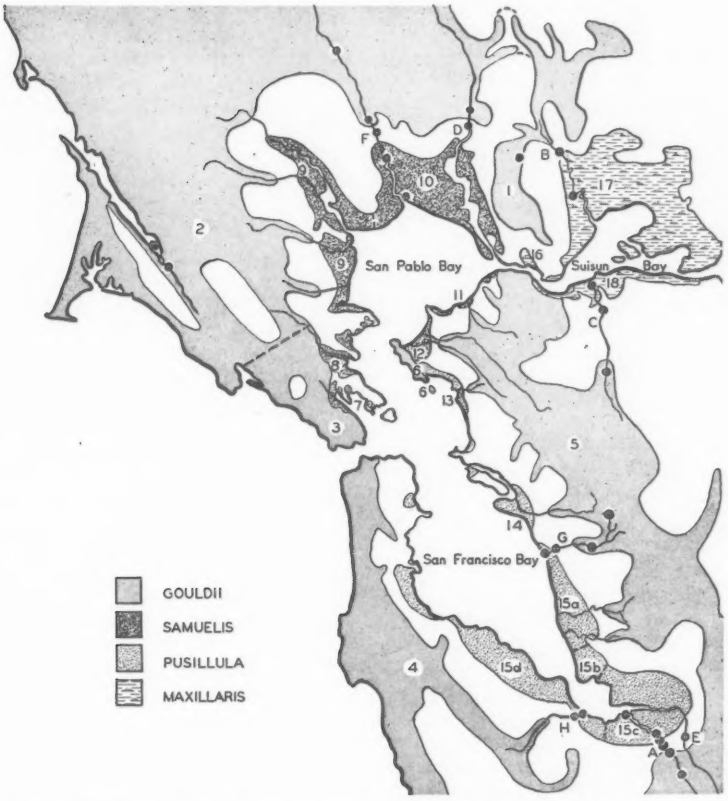

Fig. 42. Distribution of Song Sparrow populations in the San Francisco Bay region (same scale as fig. 41). Dots indicate points along the following connecting avenues from which samples will be described: (A) Guadalupe River, (B) Green Valley Creek, (C) Walnut Creek, (D) Napa River, (E) Coyote Creek, (F) Sonoma Creek, (G) San Lorenzo Creek, and (H) San Francisquito Creek. The two dots at the extreme left of the map, at Tomales Bay, refer to two samples which will be mentioned in the text, one from a salt marsh, the other from a fresh-water marsh.

Populations are numbered as follows: (1) Solano, (2) Marin, (3) Elk Valley, (4) Peninsula, (5) East Bay, (6) Richmond Hills, (7) Richardson Bay, (8) Corte Madera, (9) Petaluma, (10) Napa, (11) Pinole, (12) San Pablo, (13) Stege, (14) San Leandro and (15) San Francisco Bay. The last is divided into four sections as follows: (a) San Lorenzo Creek south to Patterson Creek, (b) Dumbarton Point, (c) Alviso and (d) Palo Alto north to San Bruno. Number (16) is Southampton Bay, (17) North Suisun and (18) South Suisun.

Connecting avenues are shown as they probably existed under natural conditions. At present the only ones which still provide continuity, though narrower than formerly, are the following streams, in order around the bay clockwise from the Golden Gate (numbers not entered on map): Corte Madera Creek (2d), Miller Creek (3rd), Novato Creek (4th), Sonoma Creek (7th), Napa River (8th), Green Valley Creek (9th), Walnut Creek (10th), San Pablo Creek (12th), Wildcat Creek (13th), San Leandro Creek (15th), Patterson Creek (18th) a recent connection not shown in figure 41, and Guadalupe River (20th).

Running between the upland and the bay marsh populations are the narrow connecting avenues, the rows of Song Sparrows along streams crossing the bayside plain. Remembering that Song Sparrow pairs occur in continuous linear sequence along banks of sloughs, streams and the seacoast, and that soft chaparral carries them over the summits of the ranges into proximity with headwaters of riparian habitat beyond, and that the sequence of territories laid end-to-end is unaffected by transition from one habitat to another (except at the mouth of San Francisquito Creek), it is at once evident that all populations are connected to each other by continuous series of breeding pairs except that at the Golden Gate, Carquinez Strait, and the dry hills surrounding Southampton Bay, there is a break in this continuity amounting to complete spatial separation.

VEGETATIONAL SUCCESSION AND THE FATE OF POPULATIONS

Fresh-water habitats.—It is possible to regard the seaside chaparral as a permanent habitat configuration which persists along the coast because it is outside the tolerance ranges of coniferous forest, which is limited here by soil and wind conditions. It provides a permanent source of Song Sparrows existing in the maximum concentration possible for the species, and it provides a reservoir for colonization of the other less stable habitats. The connecting avenues for such colonization always are present in the form of young riparian habitats, although any one stream is liable to pass into a stage where it is no longer inhabitable by Song Sparrows.

Soft chaparral is apparently a stage in the succession culminating in deciduous or coniferous forest, as it now grows in several areas where such forests once occurred and were logged off. Their regrowth will eliminate Song Sparrows from these areas. Concerning the fresh-water marshes, such as the marsh at the mouth of Olema Creek, we can see from the altitudinal progression of vegetation inland from the water's edge (*Typha-Scirpus, Salix-Juncus, Salix,* a fringe of soft chaparral, then madrone-laurel woodland) that with the filling of the body of water by deposition of soil, the *Typha-Scirpus* portion will eventually become *Salix,* which in turn will give way to moist chaparral and finally woodland. Therefore, the Song Sparrow populations in fresh-water marshes are destined to become limited to whatever narrow streams may persist there after the marshes or lakes fill up. New fresh-water marshes are populated from the birds along the streams which flow into them.

Concerning the fate of Song Sparrow populations along streams, it is obvious that the stream itself will cause the ultimate eradication of the birds because of continued deepening of the channel and consequent elimination of moisture-loving vegetation from its banks and its replacement by laurel, maple, and live oak, the culmination of which is observed at Carneros Creek, Napa County. However, there will always be riparian habitat available at the mouths of streams where sedimentation keeps filling up the channel and at inland localities where the vegetation is not sufficient to prevent erosional breakdown of the stream banks in flood times. Therefore, one can envisage the continuance of avenues of connection between (ultimately) the seaside chaparral populations and the bay marsh populations along such streams.

The requirement for forming an abrupt demarcation between riparian and contiguous salt marsh habitats is the presence of a steep alluvium at the mouth of a stream. Evidently such a situation once existed at the mouth of San Francisquito Creek, and until 1942 at the mouth of Mill Creek, which empties into the Richardson Bay salt marsh. The latter spot was at the time deemed not suitable for studies in ecologic isolation inasmuch as the bay marsh and upland birds there are practially indistinguishable and show little evidence of any kind of isolation, being continuous through soft chaparral. Considering the topography of the bay region as a whole, it seems unlikely that such an abrupt demarcation of the two habitats would ever come into being at the

mouths of most of the streams, in view of the gentleness of the slope of the bay-side plain. (There is some evidence that the alluvium at the mouth of San Francisquito Creek was started by man's activities.) It is even less likely that such a boundary would endure long enough to play a decisive role in the differentiation of races.

Brackish habitats.—We are here interested in the relative permanence of brackish habitats because of their importance in providing a blending continuity (at the mouths of streams) between upland and bay marsh Song Sparrow populations in the area surrounding Suisun and northern San Pablo bays. This intermediate zone will be pushed farther toward the bay as sediment builds up, counteracted by the deepening of the rivers permitting tides to flow farther upstream, thus carrying the brackish vegetation with them. As long as these opposing processes maintain any sort of balance, we can expect the brackish zone to persist.

Salt-marsh habitats.—The absence of wave action at the edge of the gradually sloping bay-side plain permits the growth of the marsh vegetation. As deposition continues the vegetation of the intertidal zone disappears inland as the land there is raised above the high-tide mark, and advances bayward as soil is added to the mud flats. Thus, the marsh may advance into the bay until proximity to some main tidal channel provides for the sediment to be carried away as fast as it is deposited. It must then suffer oblivion as the shore steepens, and eventually be converted into grassland, soft chaparral or oak-laurel woodland. The sucessional types are usually all represented to varying extents on a single marsh, proceeding in orderly sequence from low- to high-tide levels.

We can postulate that San Pablo marsh is young, has recently emerged from bare mud flats and is now in the *Spartina* stage of development, the lowest plant form in the altitudinal sense. This marsh is of such low elevation generally that *Spartina* covers most of it. *Salicornia* is limited to higher ground, namely the raised banks of all the sloughs and the inland belt on the periphery of the marsh, and the total area it occupies is insignificant compared to that of *Spartina*. *Grindelia*, the next higher type, is only beginning to pioneer on this marsh and is found (in my study area) in only two isolated patches and a couple of lone bushes on the highest banks available. With further raising of the level of the marsh by deposition, providing the shore-line remained stationary, we would expect *Salicornia* to encroach upon *Spartina*, which would become limited to a fringe at the shore and in the bottoms of the deepest sloughs; *Grindelia* would take over the raised banks of the sloughs, which would now be too high for *Salicornia*. This is precisely the situation found at Corte Madera and Dumbarton Point. (The marsh at Stege, Contra Costa County, has changed from pure *Spartina* to the *Salicornia-Grindelia* stage since 1940. Deposition here has been speeded up by man and his dump-trucks.) With still further deposition, the area would no longer be covered by tides; grasses and weeds such as *Chenopodium* and *Rumex* would replace *Salicornia*, and *Baccharis pilularis* would replace *Grindelia* on the slough banks and Song Sparrows would no longer dwell there. This process has progressed half-way to completion at Pinole, where the whole series, *Spartina* to *Grindelia*, is condensed into a narrow belt at the bay shore, inland from which *Chenopodium* and other weeds hold sway, although with some admixture of *Salicornia*.

Concerning the fate of a population of Song Sparrows on a salt marsh, the point of interest is that throughout the history of sucessional stages of vegetation, the marsh will continually provide "edge environments" on the raised slough banks with their floral differentiation. Furthermore, we can at least postulate that processes are at work which, barring compensatory geological events, might eventually wipe out a given salt-marsh population entirely. However, as far as I can determine, there has been no such reduction of populations through natural events in the time since Song Sparrows were

first collected in the bay region. Whole marshes have, of course, been wiped out by the activities of man. Such reclamation generally consists of halting the flow of tides and rivers by the construction of levees on the banks of rivers and sloughs, with the result that the marsh is replaced by grassland, weeds or *Baccharis*.

LIMITING FACTORS APPLYING TO SONG SPARROW ENVIRONMENT OF THE BAY REGION AS A WHOLE

From the foregoing outline of the limitations imposed on Song Sparrows in each habitat, we can conclude that the species, in the bay area at least, is limited in its distribution by appropriate extremes of vegetation, water, light and accessibility of the ground for foraging.

The Song Sparrow requires vegetation for its existence, in particular, for nesting sites, hiding places, song perches, and for concealment during the major part of its foraging. Only in rare instances does a Song Sparrow wander more than ten yards from cover, as when foraging on beaches and flying across wide sloughs and rivers. It is further dependent on this vegetation for a large part of its food, which consists, except in salt marshes, mostly of seeds picked up on the ground.

Fresh water in the form of dew is provided in all the habitats in the early morning. But the Song Sparrow requires at least some permanent water or moisture in its own territory. In fresh-water habitats this can be standing or running water, or in the case of seaside and soft chaparral, merely condensation of fog or seepage. In salt or brackish habitats the water must be tidal, that is, it must ebb and flow. This water requirement coupled with the disposition of territories in single rows along narrow bands of vegetation is somewhat different from the condition described by Nice (1937:70-71) as her maps of territories show them three or four deep along the bank of the Olentangy River. (However, the maps for central Interpont in 1934 and 1935, pp. 72-73, show territories in a single rank along the river and along various widely separated dikes.) Nice mentions (1937:12) that "The birds must leave their territories several times a day to procure water for drinking and bathing purposes." She regards this situation as not typical for the species, however.

It seems likely that Song Sparrows are limited to moist situations not as a direct consequence of particular food or plant growth provided by the water. Rather, the species manifests an instinctive preference for the moisture plus a certain configuration of vegetation, which is a psychological adaptation insuring that the individual will find suitable cover and food in such areas. In other words, food appears not to be a direct limiting factor. There are many moist situations probably providing adequate food which are not occupied by Song Sparrows. There is, moreover, a marked difference in the food of salt marsh birds from the food of those in other habitats. The former eat mostly invertebrates, the latter mostly seeds, in the non-nesting season at least.

Although Song Sparrows "delight" in foraging in dark crevices under overhanging stream and slough banks, and hide in piles of twigs or dead *Scirpus* stems which are very dark inside, yet any continuous high leafy canopy, such as coniferous forest, deciduous woodland or even tall dense willow growth is a barrier past which they never trespass, regardless of the moisture conditions that may prevail there, or the attractive appearance of the understory vegetation, even when it is composed of the identical plant species inhabited outside of the forest canopy. This suggests that the light factor operates directly on the Song Sparrow through its psychological responses, rather than indirectly by imposing limits on particular plant species which the birds inhabit. It should be noted that the leafless stems of *Scirpus acutus* and *Scirpus californicus* cast very small shadows, consequently the interior of such stands is well lighted.

The densest vegetation which Song Sparrows can tolerate is the continuous mat of foliage and stems found in *Salicornia* marshes and seaside chaparral; presumably they are able to get about in it only because it is opened up by the flow of water and the runways of small mammals. (Grassland, also permeated by *Microtus* trails, is too dry for them, does not furnish cover the year around, and offers no suitable song perches.) The densest growth in which Song Sparrows can exist without such openings at the ground level is *Scirpus campestris*. In this species, the stems generally grow one or two inches apart, and this is the lower limit at which it is physically possible for the sparrows to make their way. *Spartina*, the other *Scirpus* and *Typha* all grow farther apart. There is a species of *Juncus* in pure stands around the edge of Southampton Bay which illustrates the next stage in closeness of stems which is prohibitive to Song Sparrows. It is really a miniature of *S. acutus*; it grows on wet ground and has a round stem which ascends vertically and unbranched for 18 inches. The stems, however, are only one-half inch or less apart.

Closeness of stems is an environmental limiting factor which is tied up with the availability of the ground for foraging. As noted under the account of the several habitats, bare ground is a feature of each, and is apparently a necessity for occupancy of soft chaparral. In the other habitats, the ground must be available at least under a large part of the vegetation, either in mammal runways or by reason of separation of stems at an appropriate distance.

In summary, I might list the attributes that are common to all the Song Sparrow habitats in this area: (1) plenty of water; (2) plenty of light, furnished by low though dense growth as in *Salicornia*, or if higher, by absence of leaves as in *Scirpus acutus*, or if still higher and very leafy, by scattering of the trees in widely spaced patches separated by low vegetation; (3) plenty of vegetation which can be continuous and 4 to 10 feet high if not too leafy (*Scirpus, Spartina, Typha*), or if leafy so as to cut out light, it must be separated into patches (soft chaparral) or narrow ranks (*Salix*), or be differentiated into low and high elements (*Salicornia-Grindelia* marsh and seaside chaparral), or be widely spaced (continuous stands of *Grindelia* at Tomales Bay salt marsh, and some continuous stands of *Salix* around lake margins); (4) exposed ground or leaf litter for foraging; and (5) piles of twigs or dense shrubs for concealed foraging and for hiding. Such features common to the several kinds of Song Sparrow environments are sought as a background for a discussion of whether or not some of the "ecologic races" in the bay region are adapted to environments unique for the species, and which other Song Sparrows cannot endure. In other words, does the occupancy of salt marshes, for instance, by the races *pusillula* and *samuelis* involve a successful pioneering into a new environment, such that we could say that these races represent incipient species in the process of diverging from the rest of *Passerella melodia*?

INFRASPECIFIC ADAPTATION

Over the rest of its range *Passerella melodia*, to my knowledge, inhabits all the types of environment described here for the bay region and others, such as willow thickets in mountain meadows of the Sierra Nevada and beach vegetation in Alaska, wherever they provide the necessities outlined in the preceding statement. Each race usually occupies the several different kinds of habitat wherever they occur within its area. For instance, *cooperi* of the California coast south of San Mateo County breeds in freshwater marshes, riparian growth, soft chaparral, brackish marsh and suitable portions of *Salicornia* marshes (personal observation). *Cleonensis* (Grinnell and Miller, 1944:547) and *morphna* to the north are likewise not restricted to any one kind of habitat, although seaside chaparral is the most extensive one in their ranges.

The virtual absence of Song Sparrows (of the race *cooperi*) from the great salt marshes of coastal southern California has long been thought to be due either to their lack of adaptation to that environment or to the adverse competition with the Savannah Sparrows, which abound there. However, I found that the vegetation, although consisting of species similar to those around San Francisco Bay, is too low for Song Sparrows and is just what one would expect, from study in the "bay region," to be ideal for Savannah Sparrows. *Salicornia* grows as single erect stems six inches tall and usually unbranched; so does *Frankenia, Jaumea* and *Distichlis. Spartina* there is only 18 inches tall at the most. I have found Song Sparrows in the few spots on those marshes where man-made changes have permitted the development of patches of *Salicornia* two to three feet high, and the birds appear to be successfully established in spite of being hemmed in by the densest imaginable population of Savannah Sparrows.

At Elkhorn Slough, Monterey County, although most of the marsh is not visited by *cooperi* either because of the shortness of the *Grindelia* or possibly because of unfavorable action of tides, yet there is one spot where I found Song Sparrows foraging under the *Salicornia* and singing from tall *Grindelia* bushes. When chased, they returned to a little fresh-water marsh 100 yards away, which was the territorial headquarters for a half-dozen pairs. At least at low tide, these birds recognized the marsh as a place to forage.

Much more instructive is the occurrence of individuals of *gouldii,* the race of the San Francisco Bay region upland fresh-water environments, in *Salicornia-Grindelia* marshes at Drake Bay and Tomales Bay on the coast of Marin County. These marshes are of course far removed spatially from identical environments around San Francisco and San Pablo bays, and because of humid conditions near the coast are surrounded by fresh-water habitats. As a result the populations in them are not isolated spatially and in fact are in broad breeding continuity with typical individuals of *gouldii.* At Tomales Bay this continuity is provided not only by riparian growth and soft chaparral all along the southwest border of the marsh and much of the northeastern border, but by a gradual transition through a brackish marsh to a fresh-water marsh at the head of the bay, at the mouth of Olema Creek. Birds collected on this marsh are identical morphologically (and are undoubtedly identical genetically also) with *gouldii* which surrounds them and interbreeds with them. In summer they nest and have territories staked out all over this salt marsh; they feed under the overhanging slough banks on the same food (snails, other invertebrates, and *Grindelia* seeds) and occur in the same density as do members of the race *pusillula* in the most favorable *Salicornia-Grindelia* areas around San Francisco Bay. Fall specimens show the characteristic plumage abrasion attending life in *Salicornia* beds; therefore, these individuals are successful full-time residents on the marsh.

It is not intended in this discussion to minimize the fact that bay marsh races are superior to *gouldii* in their adaptation to salt marsh existence. Rather, it is desired to suggest that this adaptive divergence is of small magnitude compared to differences in ecology between species of the genus *Passerella*; it is a difference in degree rather than quality, and does not suggest the kind of adaptation which permits two forms to occupy simultaneously the same general area. It has not been accompanied by any noticeable difference in song, mating behavior, and particularly foraging behavior among the bay region races. They are all primarily ground foragers; the few instances of other kinds of foraging under the accounts of each habitat are regarded as very unusual, but they show that in each habitat, some birds are likely to carry on some strange kind of foraging above the ground level.

There is no evident aversion on the part of Song Sparrows of upland habitat affini-

ties to life in salt marshes, providing they are not chased out by individuals already living there and providing they dwell close enough to the marsh to become familiar with the attractive conditions which prevail. There is as much difference in vegetational configuration within bay marsh and upland categories of habitats as between them. It is suggested, therefore, that the species *Passerella melodia* is adapted to the entire range of environmental limiting factors mentioned in the preceding section, which we might call the species niche. The kinds of habitats discussed for the various populations and races in the bay region are then subniches, potentially habitable by any individual of the species. Factors such as proximity and familiarity with the subniche will determine which individuals will occupy it.

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A NESTING STUDY OF THE MOUNTAIN BLUEBIRD IN WYOMING

By FRED W. HAECKER

Nesting of the Mountain Bluebird (*Sialia currucoides*) has been reported at an elevation of only 3000 feet in the central Sierra Nevada near Fyffe, Californa (Barlow and Price, Condor, 3, 1901:184), but there seems to be no limit of altitude above this in the western United States at which this bird will not nest providing a suitable nesting situation can be found. Being a hole-nesting bird that normally seeks cavities in trees, the species would not be expected to breed above timberline, but lack of nesting cavities seems to be the only deterrent. Rowley (Condor, 41, 1939:250) has reported an instance of its breeding at an elevation of 12,000 feet in Mono County, California, well above timberline. Here the nest was placed in a niche in the side of a cliff. I once found a nest under construction in a building on the summit of Pike's Peak, above 14,000 feet, which I am sure was built by this species, for the adults were flying about. Thus, the climatic conditions of wind, light exposure, cold and snow which the Mountain Bluebird can not only withstand but apparently seeks, are worthy of note.

The observations reported here were made in 1947 on the western edge of Kemmerer in southwestern Wyoming, at an elevation of 7000 feet, in an area of virgin sagebrush hills. The mean annual precipitation is about 10 inches. Originally the only trees in the area were cottonwoods and willows along the streams and very widely scattered groves of stunted junipers among the hills. These trees remain, but in addition there are now in the town many trees that have been planted by man. The concentration of bluebirds in the area seems to be due to the large number of suitable nesting sites provided by man-made structures, including bird houses.

The bluebirds arrive in March and leave in October. My studies have shown that after a pair of bluebirds takes possession of a nesting site, there is a period of approximately a month between nesting-site acceptance and the beginning of nest building in which the birds are absent from the nesting site most of the time and may be entirely absent for days at a time. They do not, however, leave the general vicinity of the nest-site.

In 1947, bluebirds arrived in the locality on March 16, and it seemed that nearly all of the local summer residents actually arrived on that day. Nesting-box inspection began immediately. One of the boxes put up on our premises was placed on a telephone pole north of the house, about 8 feet from the ground, facing east. This box was built of cedar shakes with a hinged lid, 8 inches by 5 by 5. It was advantageously located for observation, being easily seen from several windows of our home, and I could watch the box in the early morning by merely opening my eyes while lying in bed. First inspection of the box by a pair of bluebirds was noted in the early morning of March 18. In these activities the male always took the initiative, flying back and forth between the box and the female, apparently trying to prevail upon her to accept it. On the morning of March 20 the pair had apparently accepted the box as a nesting site and both individuals were within it together at one time.

On March 22 the pair was active about the box on the pole at dawn, and on the 23rd a half inch of fresh snow was on the ground. High winds, severe snow squalls and cold weather occurred on the following day and the birds were less in evidence. On the 25th a battle occurred in a neighboring yard between a pair of English Sparrows and a pair of Mountain Bluebirds which was finally won by the sparrows. All boxes that I put up originally had a 1½-inch diameter hole. The birds would look into these boxes but would not enter. The second day after the birds arrived, March 19, all holes were en-

larged to 1¾ inches. A 1½-inch opening is the recommended size for the Eastern Bluebird, but it is apparently too small for *currucoides*, a species slightly larger than the former.

The established pair was seen only occasionally about the box from March 26 to April 13. On the 14th for the first time, the female was seen carrying nesting material into the box. The material consisted of shreds of sagebrush bark which she pulled from the living bushes. Examination showed that perhaps a fourth of the necessary material was within the box, placed as a wreath on the bottom. Thus, 29 days after the species arrived in Kemmerer and 25 days after a particular pair accepted a nesting-site, nest-building had begun. Then the birds abandoned the box for two days, and the female resumed nest building on the 17th. Her usual procedure would be to pull off a shred of sagebrush bark while standing on the ground, fly directly to the box alighting on the edge of the hole, spend less than a minute within the box, fly out and alight for less than a minute on a telephone wire and then fly to the ground for more bark. Meanwhile, the male would sit on a nearby wire watching the procedure without singing or assisting in any way, although occasionally he chased off an English Sparrow. The pair abandoned the box again on the 18th but did a little work on the 19th, and on this day the male was seen once to carry in nesting material. This was the only time during the season he was seen to participate in nest-building. Very little progress on the nest was noted in the examination made on the 20th, and the birds again left off work and were not seen about the nest at all from April 22 through April 28. They returned on the 29th but were not active about the house for the next few days. Even on May 2 very little progress in nest-building could be noted, and the nest was nearly in the same condition it had been on the evening of April 14, the first day nesting material was carried in. Considerable work was done on the nest on May 3 and 4, and on the 5th it was apparently complete. (A careful examination of the nest at the end of the season showed it to be composed entirely of sagebrush bark except for 3 or 4 small chicken feathers and one tiny shred of tinfoil. There was practically no lining, but the lining bark was slightly softer and in finer shreds than that in the remainder of the nest.) Thus, 22 days were required to build the nest, and it was not completed until 46 days after the site was accepted.

On May 6, 7 and 8 the bluebirds were very active about the nest in the early mornings, the female spending much time within the box and the male much time looking into the box. In the afternoons they were usually absent from the box. In this period no additional work on the nest was noted. In the early morning of May 9 the first egg was laid, 25 days after nest building began. Very frequent examinations of the nest revealed that one egg was laid on each of the next four days, all very early in the morning. The sixth egg was laid on the sixth day between noon and 4:45 p.m. The female started incubating that day, May 14, about 8:00 p.m. and would not leave the nest when the box was tapped nor when the lid was removed.

During the incubation period the female always made early morning feeding trips. The male did not incubate but was seen to enter the box once for a few minutes while the female was absent. In guarding the nest the male was much more active and aggressive than the female. He also spent a good deal of time looking into the box, and the female spent considerable time looking out.

On May 26 there were still six eggs in the nest, but on the 28th five eggs had hatched. The sixth egg never hatched. The incubation period was thus 13 or 14 days. The newly hatched young were naked and inactive and made no attempt to feed when I tried to excite them. Some of them may have been dead. This day the temperature was 26°F. with a strong east wind, driving snow and near blizzard conditions.

During the period that one or more young were in the nest, I wrote down in detail all activities of the parent birds during the 15-minute period each day between 5:45 and 6:00 a.m., choosing this time of day because it seemed to be about the time of greatest daily activity. I quote from my notes herewith the record for May 29, which is typical. "5:45 a.m., heavy frost. Male flies to wire near nest. Female emerges from box and sits by male. Parents fly away in opposite directions. Male returns to box and enters, then leaves and flies away. Female returns and enters. Male returns and enters while female is within. Male leaves and then returns with insect larva food in bill and sits on wire near box. Female leaves box and sits beside male. Male feeds female. Female enters box. Male flies away, then returns and looks in box, flies to wire, makes several trips from wire to ground, flies to box and apparently feeds female by leaning into box."

At 5:00 p.m. on the 29th, the nest contained only two young, one apparently dead, and one egg. On the morning of May 30 the nest contained one living young, one dead bird and one egg. By 5:00 p.m., the dead bird had been removed. Thereafter, growth of the one remaining young was rapid. On the 31st there was dark, bluish-gray down on head and back. On June 5 pin feathers were showing and had there been six birds of its size in the nest, the nest could hardly have contained them. The nestling's eyes first opened on June 6, which would be either 9 or 10 days after hatching. By June 8 the body of the young bird was almost completely covered with feathers. The nest was kept clean and only once was a fecal sac noted; this was high on the nest's edge. On the night of the 10th the female did not spend the night within the box, nor thereafter, thus making 27 nights during which she did. During this night of the 10th, there was rain turning to snow and the temperature dropped to near the freezing point. The next day, June 11, it was snowing hard at 10 a.m., and by 5 p.m. there was six inches of snow on the ground. The young bird seemed all right. It snowed most of the night, and on the morning of June 12 the young bird was dead.

It would seem that the death of this young bird was to be expected in view of the severe weather, the absence of other young in the nest, the absence of the parent at night and the probable lack of food. Only once during this storm was the female observed bringing larvae to the box. However, other bluebird nestings in the vicinity that I had under observation did not suffer, and even nestlings at a locality in the Canadian Zone at a 1000-foot higher elevation where weather conditions were more severe were not adversely affected. Such weather conditions are not unusual at these localities. Young robins in a much more exposed nest on our home were unharmed, and four young left it the next day, June 13.

I removed the dead nestling and the egg on June 12. From June 12 to 19 the adults remained about the box a good deal of the time, the male but not the female entering frequently. Then they abandoned the nesting box and spent much of their time about a shed 200 feet away on which was placed a gourd box that had been visited earlier in the same season, first by Tree Swallows and later by House Wrens but without an actual nesting of either. However, the bluebirds took no interest in the box, merely using the shed for a lookout and resting place. They continued to be seen about our home, and on July 16 the male was observed coming out of a box in a cottonwood tree in a neighbor's yard. This box is surrounded by a dense planting of Russian olives and had been used earlier in the season by a pair of English Sparrows. In late July a Western Wood Pewee dominated the area and chased all birds, including the bluebirds. On August 5 the parent bluebirds were seen feeding nearly full grown young in our yard, and it was evident that their second nesting in the birdhouse next door had been successful.

As the season advanced the male, female and young became more difficult to tell

apart. They were seen occasionally about our home until October 13, and other bluebirds were seen in the vicinity until October 22.

The feeding habits of *currucoides* always remind me of those of the Sparrow Hawk. They will perch at heights of 8 to 15 feet above the ground, usually on a wire, and turn one eye toward the ground and watch for insect prey. When this is seen they drop to the ground and take it, all very much in a Sparrow Hawk-like manner. When no high perch is available above the ground where they want to feed, they often fly, keeping their bodies nearly motionless in the air and watch the ground. In this they also resemble the Sparrow Hawk. They seldom look for food on the ground itself but nearly always from above. In the area here concerned the feeding ground was always in the sagebrush. I have seen food in their bills innumerable times but it always seems to be of the same kind, small insect larvae, about ¾ of an inch long. I have never seen them take food in the air, although other writers have. A feeding station was maintained within 50 feet of the box on the pole throughout the year but the bluebirds never used it.

Mountain Bluebirds are hardy and can withstand the weather conditions of high altitudes in early spring and mid-autumn. The species appears to be adjusted to the combined factors of severity of climate and competition for nest sites by early selection of such sites and a protracted period of nest-building. Were nest-building not protracted, the eggs and young would normally be subject to weather conditions which they could not withstand.

SUMMARY

In 1947, Mountain Bluebirds (*Sialia currucoides*) first arrived at Kemmerer, Wyoming, on March 16. Inspection of a nest box by a single pair observed throughout the 1947 nesting season occurred two days later; the site was apparently accepted four days later (March 20). The pair remained in the general vicinity of the nest-box for about three weeks before the female was observed bringing nest material to it (first noted on April 14). Nest-building extended over a period of at least 22 days; most of it occurred on May 3-4, and the nest was apparently completed on the 5th. Six eggs were laid on consecutive days beginning May 9. Incubation started with the sixth egg and lasted 13-14 days. Only 5 eggs hatched (on May 27 or 28) and the nestlings died at various ages up to two weeks (the last found dead on June 12), apparently through exposure to extreme cold. Nest-building and incubation were performed by the female. The male was observed to bring nest material to the box once (March 19). A second nesting of the same pair in a neighboring area was successful.

Kemmerer, Wyoming, March 1, 1948.

NESTINGS OF SOME SHOREBIRDS IN WESTERN ALASKA

By LAWRENCE H. WALKINSHAW

In an earlier paper (Condor, 50, 1948:64-70) I reported observations on the nesting of some passerine birds in the vicinity of the Johnson River, 30 miles west of Bethel in western Alaska, in the summer of 1946. In this same area the nests of shorebirds were a matter of major interest to our party. Presented herewith are selected notes and photographs pertaining to this group of birds.

Pluvialis dominica. Golden Plover. This plover was not uncommon at Johnson River. The call, *ter-eee,* was similar to that of the Black-bellied Plover but there was a difference and we knew when approaching a territory, prior to seeing the bird, which was scolding us. While at Johnson River I often saw a beautiful flight behavior. The bird would fly with slow wing beats high in the air, suddenly drop almost to the ground and then as quickly rise to pass far out over the tundra. Often they called as they did this.

On June 7, about one-half mile north of our cabin, I found a Golden Plover nest with three eggs on a damp spot of tundra. It was on top of a small mound surrounded by sedges, and it measured 112 mm. in diameter and 47 mm. in depth. It was lined with reindeer moss and small, smooth pieces of sticks. The irregular black spots were several millimeters in diameter and were evenly distributed over the entire egg surface. The parents flew about calling the shrill *ter-eee* call or sometimes a less shrill *kweee.* When I left the area, both flew ahead of me for some distance, eventually returning to the nest region.

That same day I found another pair of Golden Plovers even closer to camp and spent several minutes the next day searching for their nest. It was finally found on June 8 on a much higher, completely dry section of land and surrounded by sedges which were not dense but in scattered clumps. The nest was very similar to the other in construction and measured 125 mm. in diameter and 28 mm. in depth. The male was incubating the four eggs as he was on June 9. However, both birds did help with the incubation. The measurements and weights of the seven eggs were: length, 47-50.5 (48.6); width, 32.8-34.0 (33.4); weight, 23.3-25.6 (24.9).

This male flopped along ahead of us as if with a broken wing and continued to widen the distance if we left the nest region. There were still eggs here on June 20.

Squatarola squatarola. Black-bellied Plover. The first day we were at Johnson River, we found a pair of these birds just a short distance from our cabin. The male was much lighter than the male Golden Plover and appeared larger. They were rather wild, but on June 5 in the afternoon Jim Walkinshaw and I found their nest built on a little flat above one of the lakes. Because of its position on top of a mound it was in no danger of being flooded. The nest measured 141 mm. inside diameter and was lined with reindeer moss. The four eggs measured and weighed on June 5: 53.3x36.7 mm., 35 grams; 54.1x 37.5 mm., 35.9 grams; 53.5x36.6 mm., 35 grams; 53.5x36.6 mm., 34.9 grams. The eggs, white in color, were spotted with black, more of the spots being located at the larger end.

Both parents incubated the eggs. On June 8 I spent from 9:30 a.m. until 12:15 p.m. in the blind. The female came back to the nest almost before I was inside the blind and incubated until 10:35. When she left she called *ter-eee.* The male, who had been feeding about 150 meters from the nest, came on foot rapidly across the tundra and started incubating. He started incubating at 10:40 a.m. and left at 11:15 a.m. The female came up as he left but was afraid of the camera so did not stay. At 11:45 a.m. the male came back and remained there until I left at 12:15 p.m. The eggs were still in this nest on June 20.

At Johnson River the Black-bellied Plover and the Golden Plover were of about the same degree of abundance; 44 of the former and 41 of the latter were observed.

Numenius hudsonicus. Hudsonian Curlew. On June 5, 1946, I found my first pair

Fig. 43. Male Black-bellied Plover on nest, 30 miles west of Bethel, Alaska, June 8, 1946.

Fig. 44. Nest of the Black-bellied Plover shown in figure 43.

of these birds at Johnson River. The next day after a short search we located their nest, a beautifully constructed affair lined with a thick layer of reindeer moss. It measured 22.8 cm. by 20.3 cm. in diameter and was 55 mm. deep. The four eggs varied in color. One was very light buffy green covered with fine brown spots. Another was darker, with

Fig. 45. Hudsonian Curlew at nest, 30 miles west of Bethel, Alaska, June 15, 1946.

Fig. 46. Nest of the Hudsonian Curlew shown in figure 45; photographed June 6, 1946.

a bluish green ground color and was covered with fine spots and some scrawls of black. The third and fourth were alike with a ground color of darker greenish and large spots of gray-green somewhat concentrated at the larger end.

These eggs ranged between 56.5 and 60.0 mm. in length and between 39.0 and 40.1 mm. in width. Weights ranged between 38.7 and 43.0 grams.

Near the nest, not ten meters away, was a Pintail's nest, and only about 100 meters

the nest of a Long-tailed Jaeger. Across a ditchlike creek was the nest of a Parasitic Jaeger and a Ptarmigan's nest as well as one of an Alaska Longspur and that of another Pintail. The only birds of this nesting community that seemed to trouble each other were the Long-tailed Jaeger and the Hudsonian Curlew. If one of these birds flew over the nest of the other a chase ensued until the other bird returned to his own region. Both nests still contained eggs when last examined on June 16.

Curlews' nests were not hard to find because the birds started calling at the first sight of a man. The call, *ter-loo-loo-loo,* was uttered by both birds as they flew about us and the closer to the nest we approached the more excited they became.

Another nest with four eggs was found June 17 on a low tundra area, again only a short distance from another Long-tailed Jaeger's nest. At this nest the curlews attacked a pair of Sandhill Cranes when they alighted near the curlew's nest, and the jaegers and curlews had no better relationship than at the other location, chasing each other if one approached the other's nest. This nest was lined with lichens and fine cotton sedge leaves and measured 142 mm. across and 60 mm. in depth inside. The four eggs ranged between 57.3 and 59.5 mm. in length, between 40.5 and 41.6 mm. in width, and between 47.7 and 54.6 grams in weight on June 17. The average measurements and weights for the eight eggs were 58.3x40.4 mm. and 45.7 grams.

Ereunetes mauri. Western Sandpiper. This species was very common at Bethel, Johnson River and Chevak. Nests were found on June 4 (2), June 5 (3), June 6 (1), June 17 (2) and many more could have been found. Downy young were first found on June 17 (two broods) and two broods were observed on June 18.

The nests were sunken into the moss on little rises of tundra, were arched over with sedges and grasses and often were protected additionally by the branches of the short tundra vegetation—Alaska tea, crowberry or dwarf birch. Usually the nests were lined with some reindeer moss, sedges and dead leaves of the dwarf birch. Measurements of nests were: 70 to 78 mm. in diameter and 38 to 48 mm. in depth.

One set contained three eggs, the remaining seven sets contained four. The eggs were somewhat cream colored and were covered with reddish brown spots. They were rather sharply pointed and the small ends were placed in the bottom of the nest. Measurements and weights of 23 eggs are: length, 30-32.8 (31.4); width, 21.1-23 (22.13); weight, 5.8-8.2 (6.84) grams.

Often, when leaving the nest almost under our feet, these little sandpipers used the broken-wing ruse trying to lead us from their eggs. Again they would fly a short distance, returning to a spot near the nest. One of the calls given at this time was *zwee-zwee-zweer.* Again they would call *tweedle-lee.* Males were often observed giving a flight song, sailing down from about 30 meters above ground on set wings, and calling *tweer-tweer-tweer.*

Lobipes lobatus. Northern Phalarope. This species was first observed at Bethel on June 2, 1946, and at Johnson River I found it almost daily. Joseph Andrews located a nest on June 8 in a shallow marshy spot covered with groups of sedges. The nest was quite snipe-like and was arched over with sedges. The male departed from the nest hurriedly and did not return while we were near. The four eggs averaged in measurements and weights: 29.2x20.8 mm., weight, 6.0 grams. On June 15 the male was incubating.

On June 17 we watched a female Northern Phalarope chasing a male in a small lake near our cabin. He was trying to feed but she repeatedly approached him in the shallow water, sometimes by foot, again by air, often forcing him to swim. Apparently she was courting him.

Battle Creek, Michigan, August 15, 1947.

A NEW SUBSPECIES OF EARED POOR-WILL FROM GUERRERO, MEXICO

By ALDEN H. MILLER

Among rarities in the Mexican collections of the late Milton S. Ray are two Eared Poor-wills of the genus *Otophanes* taken by Wilmot W. Brown in the vicinity of Chilpancingo, Guerrero, Mexico. The species *Otophanes mcleodii* has for long been known principally from two specimens: the type, a female in the Brewster Collection at the Museum of Comparative Zoology, which was taken in the Sierra Madre of western Chihuahua by McLeod on December 6, 1884 (Brewster, Auk, 5, 1888:89), and a male in the British Museum taken at Hacienda de San Marcos, 8000 feet, Zapotlan, Jalisco, by Lloyd on May 11, 1889 (Hartert, Cat. Birds Brit. Mus., 16, 1892:582; Salvin and Godman, Biologia Centrali-Americana, Aves, 2, 1894:392). The supposed occurrence of the species in Sonora and Vera Cruz (Sharpe, Hand-list Birds, 2, 1900:83) has properly been doubted (Peters, Birds World, 4, 1940:195; van Rossem, Occas. Papers, Mus. Zool., Louisiana State Univ., 21, 1945:293). No truly new information on this poor-will seems to have appeared in the literature since the early part of the century. Recently, Ed N. Harrison and W. J. Scheffler have taken four *Otophanes mcleodii* on the Sonora-Chihuahua line at the headwaters of the Alamos River of extreme southern Sonora, latitude 27° 7′, longitude 108° 35′, 5000 feet.

When the Guerreran specimens were first examined, it was not apparent whether they were closely related to *Otophanes mcleodii* or annectent with *Otophanes yucatanicus*, a species which has been generically separated from *Otophanes* as *Caprimulgus* (Hartert, *op. cit.*: 525) and later as *Nyctagreus* (Nelson, Proc. Biol. Soc. Wash., 14, 1901:171; Ridgway, Bull. U. S. Nat. Mus. No. 50, pt. 6, 1914:556).

After assembling comparative material it became obvious that the Guerreran birds were in no way intermediate in characteristics between *mcleodii* and *yucatanicus*, even though they were intermediate geographically and were darker colored than *mcleodii*. In all aspects of pattern, most importantly the lack of dark shaft streaks on the crown, back, breast shield, and tertials and the presence of well defined sagittate white spots, rather than bars, on the upper belly, the Guerreran birds show complete accordance with *mcleodii*. The shape and development of the ear tufts in them also is similar. There is as yet, then, no evidence that *yucatanicus* and *mcleodii* are linked as one species, and although such linkage is still not impossible, the situation in Guerrero reduces this likelihood.

Grateful acknowledgement is made to Ed N. Harrison for the loan of two specimens of *O. mcleodii* and to Dr. Herbert Friedmann of the United States National Museum for loan of three *Otophanes yucatanicus* from Campeche, Mexico, and Petén, Guatemala.

The Guerreran Eared Poor-wills may be described as a race of *O. mcleodii* because of distinct differences in tone of coloration. The subspecies is named in honor of Milton S. Ray.

Otophanes mcleodii rayi, new subspecies

Type.—Female, number 107138 Mus. Vert. Zool., taken in mountains above Chilpancingo, at 6000 feet, Guerrero, Mexico, August 8, 1941, by Wilmot W. Brown; ovaries minute, iris brown.

Diagnosis.—Coloration generally darker than in *Otophanes mcleodii mcleodii*; feathers of breast shield and scapulars with whitish vermiculations reduced and tawny, thus less frosted in appearance than in *O. m. mcleodii*; belly and under tail coverts Tawny and Clay Color rather than Pinkish Buff; chin, auriculars, crown, back and remiges duskier in male, richer and red brown in female than in *O. m. mcleodii*.

Range.—Known only from the mountains of southern Guerrero in the vicinity of Chilpancingo.

Measurements in Millimeters

	Wing	Tail	White tip of fourth rectrix	Tarsus	Middle toe without claw	Length of rictal bristles
O. m. rayi						
Female, type	127.9[1]	110.8	11.2	16.2	15.3	42
Male, M.V.Z. no. 107137	125.5	112.3	13.4	16.4	16.7	36
O. m. mcleodii						
Female, Harrison Coll.	128.3 (worn)	108.3 (worn)	12.1	16.5	17.0	37
Male, Harrison Coll.	130.1	110.4	12.0	16.8	17.9	37
O. yucatanicus						
Female, U.S.N.M. 167751	110.2	99.3	5.0	15.7	15.2	35
Female, U.S.N.M 167752	112.7	.....	8.0	15.5	15.4	34
Female, U.S.N.M. 302472	.....	.....	.....	15.6	15.2	....

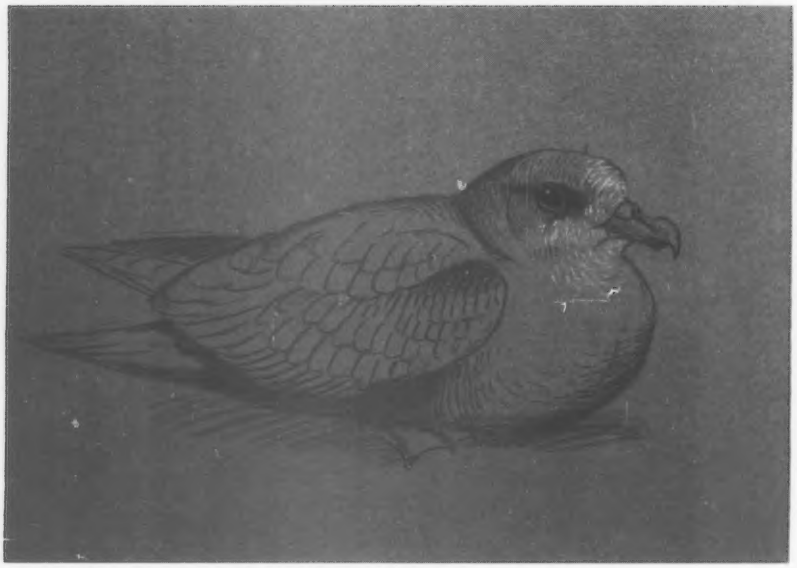
[1] Longest primary not fully grown.

W. W. Brown writes as follows (April 22, 1948) concerning the taking of the two specimens of *O. m. rayi*: "One specimen, the first [♂, May 5, 1938], was taken at night at Chilpancingo. The other specimen, the last [♀, the type], was taken in a deep ravine in the mountains above Chilpancingo at about 6000 ft. It was flushed from the ground among the rocks, but alighted on a boulder at the foot of a cliff about 40 yards from where it was flushed. It was collected at about 10 o'clock in the morning and its reddish brown plumage made it a conspicuous object in the bright sunshine as it was flushed from the ground. I have taken only two specimens of *Otophanes* and know of no others being taken in Guerrero."

The female of *rayi* is in fresh body plumage and the primaries and tail feathers are still molting; the ninth primary is about half grown and the tenth is old. Of the white-tipped rectrices, all but 3 (pair 3 and 1 of pair 4) are buff tipped and probably are juvenal feathers. The incoming rectrices are white tipped. The bird thus probably is in its first year; the ovaries were inactive. The male is in spring plumage, which is only moderately worn. On the label it is noted that the testes were fully enlarged and the iris brown. The plumage is closely comparable in wear to that of the May-taken male *O. m. mcleodii* from Sonora which was used for comparison; the female *O. m. mcleodii* on the other hand shows much more seasonal wear and fade, especially of the wings and tail. Presumably these *O. m. mcleodii* were breeding.

The darkening of the coloration of the species *O. mcleodii* to the southward parallels that of a number of other montane birds in Mexico.

Museum of Vertebrate Zoology, Berkeley, California, June 14, 1948.



GREAT-WINGED PETREL, *PTERODROMA MACROPTERA*
A sketch by Allan Brooks

FROM FIELD AND STUDY

A Nesting Census from the Subalpine Belt of Colorado.—From July 5 to August 10, 1947, a count of nesting birds was made on a 22-acre area located at 9700 feet altitude about one mile north of Gothic and ten miles north of Crested Butte, Colorado. The census area was an approximately rectangular strip 1800 feet long, bordered on the west side by the East River and cut by a road between Schofield Pass and Gothic. A total of 31 hours was devoted to this census. Major habitat types and percentages of the census area represented by them were as folows: open water (streams or ponds), 1.0 per cent; dirt roads or rocky areas, 1.5 per cent; Engelmann spruce-alpine fir climax, 10.0 per cent; aspen subclimax, 10.5 per cent; shrubs (predominantly willows), 28.0 per cent; open meadows, 49.0 per cent. The whole area was mapped and locations of singing males or nests recorded. Following is a list of species and numbers of pairs whose nesting territories were located on the census area or whose nests were actually found there.

Red-shafted Flicker (*Colaptes cafer*)	1 pair
Red-naped Sapsucker (*Sphyrapicus varius*)	2
Western Wood Pewee (*Contopus richardsonii*)	1
Mountain Chickadee (*Parus gambeli*)	3
House Wren (*Troglodytes aëdon*)	1
Robin (*Turdus migratorius*)	1 (or more)
Ruby-crowned Kinglet (*Regulus calendula*)	3
Warbling Vireo (*Vireo gilvus*)	1
Yellow Warbler (*Dendroica aestiva*)	2 (possibly 3)
Tolmie Warbler (*Oporornis tolmiei*)	2
Pileolated Warbler (*Wilsonia pusilla*)	2
Red-wing (*Agelaius phoeniceus*)	1
Gray-headed Junco (*Junco caniceps*)	3 (possibly 4)
White-crowned Sparrow (*Zonotrichia leucophrys*)	6
Lincoln Sparrow (*Melospiza lincolnii*)	14

In addition to these species, there were others which definitely nested in the census area, but whose territories were not identified nor nests located. They are as follows: Spotted Sandpiper (*Actitis macularia*), 1 pair; Broad-tailed Hummingbird (*Selasphorus platycercus*), probably 3 males, and 4 or 5 females; and Mountain Bluebird (*Sialia currucoides*), 1 pair. Five species present locally, some of which might have nested in the area, are as follows: Dusky Grouse (*Dendragapus obscurus*), Rocky Mountain Jay (*Perisoreus canadensis*), Pine Siskin (*Spinus pinus*), Pine Grosbeak (*Pinicola enucleator*), and Rufous Hummingbird (*Selasphorus rufus*).

The total number of species found on the census area was 23; of these 18 nested there. The number of pairs totalled at least 43 per 22 acres (1.96 pairs per acre), and there may have been as many as 52 pairs.

Two nests of the Red-naped Sapsucker were located on July 13 and 26, respectively, both in aspens, about 25 feet from the ground. The young left both nests about August 1. One nest of the Red-shafted Flicker was found about 50 feet above the ground in a dead aspen. The Western Wood Pewee was regularly seen and heard from top perches in an area of spruce and fir. Three territories of the Mountain Chickadee were located in spruce-fir areas. One territory of the House Wren was located in an aspen grove, and it is probable that the nest was placed in a cavity of one of these trees. Only one nest of the Robin was found, and that nest, although it was empty when found July 23, was a fresh nest of the season. All the territories of the Ruby-crowned Kinglet were in spruce-fir areas. One territory of the Warbling Vireo was located in an aspen grove. Yellow Warblers consistently preferred willow thickets. Both nests of the two pairs of Tolmie Warblers established in the census area were found: On July 23, the three, possibly four fledglings from the first nest were present nearby; the nest was situated about three feet above the ground in a four-foot spruce. The second nest was located about three feet above the ground in a willow; its four young left on July 27. Two territories of the Pileolated Warbler were restricted to willow thickets. One pair of Red-wings was present in a swampy area formerly used by beavers. The habitat occupied by the Gray-headed Junco was hard to define; generally it contained some spruce, fir, or aspen growth bordered by an open area. Nests of

the White-crowned Sparrow, second most numerous species in the area, were located in most cases under a grassy tuft in an open area, close to a willow used as a song post. A nest found on July 14 contained one young which left a few days later; the three young of a nest found on July 6 left on July 9; the four young of a nest found on July 16 left on July 22 and 23. The last nest was situated 1½ feet above the ground in a three-foot spruce. A total of fourteen territories of the Lincoln Sparrow were located, and there may have been one or two more; each was placed in a moist or swampy willow thicket. One pair of Spotted Sandpipers was regularly seen on East River, and later two young were found. The Broad-tailed Hummingbird definitely nested on the census area, but the number of adults present was difficult to determine. The Rufous Hummingbird started to appear on the census area in numbers in late July, and it was common at the time the study was stopped on August 10. Rufous Hummingbirds were observed chasing Broad-tailed Hummingbirds, but this usual territorial antagonism among hummingbirds cannot be regarded as evidence of nesting.

This study was carried out under the supervision of Dr. Francis Trembley of Bethlehem University as a research project at the Rocky Mountain Biological Laboratory.—Tom C. McHugh, *17004 Lakewood Heights Boulevard, Lakewood, Ohio, June 1, 1948.*

Boat-billed Heron in East-central Tamaulipas, Mexico.—A party of three hunters from the United States, accompanied by two Mexican guides, observed several Boat-billed Herons, *Cochlearius cochlearius,* early in 1948 on the Rio Soto la Marina in east-central Tamaulipas, Mexico. This river is about 125 miles south of Brownsville, Texas, and the party observed the birds about 25 miles inland from the coast. Twelve birds were found on January 31, and 20 at the same locality on the following day. A dead bird, brought to camp on February 3, was examined closely by all members of the party, and colored motion pictures were taken of it. It was not preserved as a specimen.

The birds permitted the men to approach by boat almost to the bases of the trees in which they perched before flying. From the fact that there was some variation in plumage, it was judged that there were both immature and adult birds in the flocks.

This observation has come to light through one of the party, Louis A. Klewer, a professional outdoor writer of Toledo, Ohio. Klewer has been an observer of birds for more than 25 years and has participated in the banding of many Black-crowned Night Herons and other herons in the eastern United States. He immediately recognized that the Mexican bird was something new to his experience, and further study after his return convinced him that he had seen the Boat-bill. This identification was confirmed later by examination of a specimen of *Cochlearius cochlearius* loaned by the University of Michigan Museum of Zoology.

These observations extend the known range of this species approximately 75 miles to the north. Earlier records from southern Tamaulipas have been summarized by Sutton and Pettingill (Auk, 59, 1942:8).—Harold Mayfield, *2557 Portsmouth Avenue, Toledo, Ohio, June 1, 1948.*

Whistling Swan in Ventura County.—On December 1, 1947, an adult male Whistling Swan, *Cygnus columbianus,* was captured alive by Mrs. Mary Searcy in a pool in the Sespe Creek, about two miles north of Fillmore. It was exhausted when taken, and was placed in a small wire enclosure and given food and water. There were blood stains on the feathers at the left base of the neck, and a large bruise was visible on the tip of the left wing. Five days later the bird died and was given to W. J. Sheffler of Los Angeles who stated that its death was caused by an infestation of maggots that ate through the esophagus and most of the flesh on the neck at the point of entry. It is now no. 2701 in Mr. Sheffler's collection.—Sidney B. Peyton, *Fillmore, California, April 2, 1948.*

Another Black Pigeon Hawk from California.—While driving south on U. S. Highway No. 99 on October 27, 1947, I found an adult female *Falco columbarius suckleyi* lying dead beside the pavement about four miles south of Willows, Glenn County, California. As the waterfowl season was open at the time and hunters were plentiful within the area, I assume the bird was killed by one of these. When found, it had been dead two or three days but was in good condition to be prepared as a specimen.—Stanley G. Jewett, *Portland, Oregon, December 30, 1947.*

Red-wing in Southeastern Alaska.—On July 1, 1946, I was tramping across the grassy tidal marshes of Sergeif Island, at the mouth of the Stikine River, southeastern Alaska, when I was startled to hear the familiar call note of a Red-winged Blackbird. The bird circled high over my head, then landed on a cottonwood snag near by, where I shot it. The specimen (now in the collection of the California Academy of Sciences) proved to be a second-year male which I identify as *Agelaius phoeniceus arctolegus*. There is no previous published record for this species from southeastern Alaska, but there is a specimen in the Museum of Vertebrate Zoology. The skin (no. 44616) lacks a head and is unsexed, but is in adult female plumage. The original label indicates that it was taken by Allen Hasselborg at Mole Harbor, Admiralty Island, in the summer of 1924. (No doubt it was shot by Hasselborg with his famous bear gun.) It bears the notation, in the handwriting of the late H. S. Swarth, "Probably *arctolegus* H. S. S." The writer identifies this specimen, also, as *arctolegus*.

The extreme northwestern corner of the breeding range of the race *arctolegus* is in southeastern Yukon Territory (Rand, Nat. Mus. Canada Bull. 105, 1946:59). Farther west there are records, apparently of vagrants, from Atlin, in northwestern British Columbia (Swarth, Proc. Calif. Acad. Sci., ser. 4, 23, 1936:54), and from Cape Prince of Wales, in extreme northwestern Alaska (Bailey, Condor, 32, 1930:161 and Proc. Colo. Mus. Nat. Hist., 18, 1943:109). The northernmost definite record of the coastal race, *caurinus*, is from Comox, British Columbia (Macoun and Macoun, Cat. Canadian Birds, 1909:431).

I am indebted to the authorities of the Museum of Vertebrate Zoology for permission to record the Hasselborg specimen and to study the collection under their care.—J. Dan Webster, *Jamestown College, Jamestown, North Dakota, April 4, 1948.*

Young Short-eared Owl "Captured" by Plant.—On June 14, 1947, while working the Fern Ridge Reservoir west of Eugene, Oregon, I came upon an immature Short-eared Owl (*Asio flammeus*) in a rather unusual circumstance.

This bird did not have fully formed primaries and so was unable to fly. It had left the nest and wandered through the grass until it came to a ditch filled with water. The owl was apparently moving along the edge of this ditch when it came into contact with a plant of the common tar-weed (*Madia sativa*) which has very sticky-glandular leaves. The young owl became trapped with two of the leaves firmly attached to the feathers on the top of its head.

When I came upon this owl, it was able to move but a few inches forward or backward. Had I not freed the bird it would certainly have lost its life. To free the bird it was necessary to remove the leaves from the plant and then pull the feathers out of the bird's head to which the leaves were stuck. The feathers could not be freed from the leaves.

In areas where this plant is common it might be a source of some loss of life among young birds of the ground dwelling species.

The young owl now wears band number 45-624031.—Gordon W. Gullion, *Eugene, Oregon, July 1, 1948.*

Correction to Description of Chordeiles minor twomeyi.—Owing to a catalogue error, the number of the type specimen of *Chordeiles minor twomeyi* Hawkins given as 131,534 in the description (Condor, 50, 1948:131) should be changed to read 131,840.—W. E. Clyde Todd, *Carnegie Museum, Pittsburgh, Pennsylvania, June 3, 1948.*

NOTES AND NEWS

Fig. 47. Ralph Arnold, member of the Club since October 3, 1893.

The colored portrait of a Cooper Hawk (*Accipiter cooperii*) by Allan Brooks, which appears as the frontispiece in this issue, is based on an adult bird taken in June, 1939, at Okanagan, British Columbia. Original notes by Brooks on color of soft parts are as follows: eye, scarlet; cere, orbital ridge and eyelid (narrowly), greenish yellow; gape and feet, light cadmium yellow.

PUBLICATIONS REVIEWED

BIRDS OF ARCTIC ALASKA. By Alfred M. Bailey. Colorado Museum of Natural History, Popular Series, Number 8, April 1, 1948, 317 pp., 102 figs., one map.

Although primarily a distributional list of the birds of the Arctic slope of Alaska, this work includes a valuable chapter on the vegetation of the Arctic slope by Joseph Ewan, a history of ornithological work in this area, the author's first-hand account of migration along the Arctic coast, and a running narrative of the work of field parties of which he was a member. Persons working with birds collected in this area will find particularly useful the taxonomic notes, sketch map, gazeteer, and bibliography of over 150 titles. The illustrative material consists of over one hundred photographs, some of which have been retouched. Of particular note are those of the nests and eggs of northern birds and of migrating flights of eiders and murres. Pictures of some of the more common tundra plants, habitat and travelog shots, and portraits of the field workers who contributed most of the study of this area are also of considerable interest. Of questionable value are photographs of dead birds and of museum habitat groups.

The region covered consists largely of tundra, though some wooded areas in the drainage of Kotzebue Sound are included in the report and materially increase the number of forms recorded. One is frequently over-impressed by the number of Palaearctic forms recorded from northern Alaska; hence it may come as a surprise to find that of slightly over two hundred forms listed from this area, only thirty-one are Asiatic and two of this number have yet to be collected in northern Alaska. Of the forms listed as accidental or rare, only approximately 28 per cent are Asiatic. This is what might be expected on the basis of probability, but there is a strong tendency to remember most easily the stragglers from the Palaearctic Region because they do not (in most cases) occur elsewhere in North America.

Of the many reasons for publishing carefully prepared, comprehensive regional lists, not the least important is that of pointing out what lines of future research may prove most fruitful. It is in this and in providing a foundation for such work that Bailey's book will have its greatest value. Reading it, one is struck by the need for study of such problems as those of the areas of overlap of the ranges of Eurasian and American forms such as the Pacific and Green-throated loons, which are elsewhere allopatric; the relative abundance of the various species of shorebirds with respect to the size of the bird and to habitat preference; comparisons of the behavior and feeding habits of many forms on their wintering and summering grounds; and the isolating mechanisms in breeding behavior which prevent the hybridization of such sympatric species as the two species of murres.

The book is well designed and executed, but

contains several lapsi such as giving the incorrect initials for L. M. Huey (p. 11) and the implication that half-grown ptarmigan breed (p. 51). On the whole it is a valuable compilation of information on the birds and general features of a region, which, due to air travel, is rapidly becoming less remote.—ROBERT W. STORER.

COOPER CLUB MEETINGS

ANNUAL MEETING

The Nineteenth Annual Meeting of the Cooper Ornithological Club was held in Pacific Grove, California, on Friday, Saturday, and Sunday, May 7-9, 1948. The program arranged by a committee of the Northern Division contained the following papers:

May 7, morning session, F. A. Pitelka presiding. Some Behavior Patterns of the Gannet, R. W. Storer; Territorial Relations of Anna and Allen Hummingbirds, F. A. Pitelka.

May 7, afternoon session, R. T. Orr presiding. Notes on the Black Brant on the East Coast of Vancouver Island, Theed Pearse; Fall Migration at Hawk Mountain, Pennsylvania, 1947, Junea W. Kelly; Failure of the Species Concept in the Genus *Pipilo*, Charles G. Sibley; New Avian Records for the Pliocene of California, Hildegarde Howard; Birds from the Jones Fauna of the Kansas Pleistocene, T. Downs; Sex and Age Variation in the Common Murre, Robert W. Storer; Observations on a Sense of Smell in Turkey Vultures, Kenneth E. Stager.

May 8, morning session, Charles G. Sibley presiding. Nesting of the Bullock Oriole on the Hastings Reservation, Jean M. Linsdale; The Nocturnal Singing of Birds, Alden H. Miller; Problems of Bird Distribution in Hawaii National Park, Paul H. Baldwin; Some Results of a Banding Study of the Plain Titmouse, Keith L. Dixon; Some Aspects of a Behavior Study of the Brewer Blackbird, Laidlaw O. Williams.

May 8, afternoon session, Charles G. Sibley presiding. Condor Courtship, Carl Koford; Song Sparrows of the San Francisco Bay Region, Joe T. Marshall, Jr.; Observations on the Seasonal Behavior of the Common Merganser, Robert T. Orr; Bathing and Roosting Habits of the California Condor, Ed N. Harrison and Frances F. Roberts; Southern Exposures, Laurel Reynolds.

At an informal meeting Saturday evening, a film entitled "A Sonoran Journey" was shown by Ed N. Harrison and Frances F. Roberts.

On Sunday, May 9, Field trips were conducted to the Hastings Reservation and to Point Lobos State Park and neighboring coast areas.

GOVERNORS' MEETING

The 23d annual meeting of the Board of Governors of the Cooper Ornithological Club was held on May 7, 1948, at Class Hall, Asilomar, in Pacific Grove, California. President Alden H. Miller called the meeting to order at 7:30 p.m., with the following members present: W. Lee Chambers, C. V. Duff, Walter K. Fisher, W. I. Follett, Dorothy E. Groner, Ed N. Harrison, Hildegarde Howard, Junea W. Kelly, Eric C. Kinsey, C. B. Lastreto, Jean M. Linsdale, Alden H. Miller, R. C. Miller, R. T. Moore, Harry R. Painton, Frank A. Pitelka, Charles G. Sibley, K. E. Stager, R. W. Storer, E. Lowell Sumner, and John G. Tyler. Guests present: Stanley G. Jewett and Otto J. Zahn. Proxies were present as follows: F. N. Bassett, H. C. Bryant, H. W. Carriger, R. B. Cowles, John T. Emlen, Jean M. Linsdale, Luther Little, Loye Miller, Sidney B. Peyton, Gayle Pickwell, J. McB. Robertson, Howard Robertson, and S. F. Wood, held by Alden H. Miller; Hilda W. Grinnell, Harold Michener, J. R. Pemberton, T. I. Storer, and A. J. van Rossem, held by Frank A. Pitelka; and Louis B. Bishop, held by W. Lee Chambers.

Minutes of the 22nd annual meeting were read and approved. The report of the Treasurer was submitted jointly by John McB. Robertson and W. Lee Chambers. Mr. Chambers called attention orally to important items of the report and trends indicated by them. At present, accounts covering the Pacific Coast Avifauna series are favorably balanced; however, with repeated increases in current printing costs this is not true of the Condor accounts. It was moved by C. B. Lastreto, seconded by H. R. Painton, that the report of the treasurer be accepted pending examination of it by the Auditing Committee.

C. V. Duff called attention to the need of initiating preparation of the fifth ten-year index, covering the years 1939-1948. A discussion of problems associated with this and earlier indices then ensued.

A. H. Miller presented the report of the editors of The Condor. Since 1947, costs of publishing The Condor have risen 30 per cent. Arrangements with the printer which have helped to limit cost rise have been reduction of amount of text in 8-point type, wider line-spacing in 8-point text, production of issues consisting only of 8-page fascicles, and reduced number of corrections on

galley proof. It was expected that charges will now be levied by the printer for proof-changes and changes in the mailing list. The board was advised to anticipate the possible need for an increase in dues. The editors went on record as not favoring change of printers to a region where costs might be somewhat less, as considerable inconvenience in publication procedure would result; nor did they favor any reduction in the size of The Condor. Number of manuscripts submitted for publication was said to be increasing. It was moved by E. L. Sumner, seconded by R. C. Miller, that the report of the editors be accepted.

It was suggested by A. H. Miller that the board take such action as is necessary to permit a raise in dues should this prove necessary. It was moved by R. T. Moore, seconded by C. G. Sibley, that an amendment to the by-laws be drafted, permitting an increase in annual dues if such is deemed advisable by the Board of Directors. Considerable discussion of this problem ensued, and opposing views were freely expressed.

C. V. Duff announced a name-grant supported by Harry R. Painton, to be used in provision of a scholarship for students in ornithology at the University of California at Los Angeles.

It was reported by the President that the Northern and Southern divisions took action calling upon the Board of Governors to appoint a committee to study qualifications to be considered when nominations for honorary members are suggested. This committee, appointed in February, 1948, consists of W. Lee Chambers, Hildegarde Howard, Carl B. Koford, Jean M. Linsdale (chairman), Loye H. Miller and R. T. Orr. The report of the committee, read by J. M. Linsdale, stressed among other points that a primary qualification of nominees should be service to the Cooper Club and to western ornithology. It was moved by E. C. Kinsey, seconded by C. B. Lastreto, that the report be accepted with appreciation and that the recommendations made be followed henceforth.

Mr. Stanley G. Jewett reported a threat of partitioning of the Malheur Lake Wildlife Refuge, involving a removal of over 23,000 acres from the present 158,000 acre refuge area, this area to be reclaimed for supposed use in diversified farming. It was moved by W. Lee Chambers, seconded by H. R. Painton, that resolutions opposing this partitioning of the Malheur Lake Refuge be drawn up and submitted to the Club as a whole at its Business Meeting.

On the motion of C. V. Duff, seconded by W. I. Follett, incumbent officers were reelected. [Subsequently, upon request to assume another office, A. H. Miller resigned as president of the board.] On the motion of Hildegarde Howard, seconded by Ed N. Harrison, the present editors were asked to continue service for the coming year.

It was moved by E. C. Kinsey, seconded by F. A. Pitelka, that a committee be selected by the President of the Board of Governors to appoint a Cooper Club representative to the AOU council.—FRANK A. PITELKA, *Secretary*.

NORTHERN DIVISION

APRIL.—The regular monthly meeting of the Northern Division of the Cooper Ornithological Club was held on Thursday, April 22, 1948, in Room 2503 Life Sciences Building, University of California, Berkeley, with Dr. Pitelka presiding and 55 members and guests present. Proposals for membership were read as follows: Harold E. Kliéforth, 119 Laurel Ave., San Anselmo, Calif., by F. A. Pitelka; Miss Sarah Wheatland, Hopkins Marine Station, Pacific Grove, Calif., by L. O. Williams; and G. Ruhland Rebmann, Jr., 1418 Packard Bldg., Philadelphia 2, Pa., and Carlos Sanchez-Mejorada, Jr., Montes Urales 632, Lomas de Chapultepec, Mexico, D. F., by C. V. Duff.

Mrs. Margaret M. Nice presented an account of a nesting study of the Carolina Wren.—KEITH L. DIXON, *Acting Secretary*.

JUNE.—The regular monthly meeting of the Northern Division of the Cooper Ornithological Club was held on Thursday, June 24, 1948, at 8:00 p.m. in Room 2503 Life Sciences Building, University of California, Berkeley. Vice-president Kelly presided and 20 members and guests were present. The following names were proposed for membership: Dr. Douglas D. Stafford, 912 Grand St., Alameda, Calif., by Junea W. Kelly; Walter E. Howard, San Joaquin Experimental Range, O'Neals, Calif., by J. M. Linsdale; Mrs. J. B. Spellar, Pebble Beach, Calif., by Laidlaw Williams; and Raymond F. Dasman, 1815 Sonoma Ave., Berkeley, Calif., by K. L. Dixon. The proposal for honorary membership of Dr. Louis B. Bishop was read for the second time and unanimously approved by those present.

Informal reports on recent field observations were given by various members. The meeting was adjourned early to permit those present to see a film entitled "Harvest of the Sea," shown in conjunction with the summer meetings of the A.A.A.S.—CHARLES G. SIBLEY, *Secretary*.

For Sale, Exchange and Want Column—Each Cooper Club member is entitled to one advertising notice in any issue of The Condor free. Notices of over 5 lines will be charged for at the rate of 25 cents per line. For this department, address SIDNEY B. PEYTON, R. D. No. 2, Box 260, Fillmore, California.

WANTED—Peters' Birds of the World, vol. I, new or used; U. S. National Museum Bulletin No. 160.—HENRY E. CHILDS, JR., *441 Boynton Avenue, Berkeley 7, California.*

WANTED—The combination 410 and .22 caliber gun called the "Game-getter," manufactured by Marlin.—FRANK A. HARTMAN, *Hamilton Hall, Ohio State Univ., Columbus 10, Ohio.*

WANTED—At reasonable prices, new or used: Dwight, The Sequence of Plumages and Moults of Passerine Birds; Nicholson, The Art of Bird Watching; Armstrong, The Way Birds Live; Armstrong, Bird Display; Saunders, A Guide to Bird Song.—JAMES HODGES, *3132 Fair Ave., Davenport, Iowa.*

WANTED—Vol. I, numbers 1 and 4, vol. II, numbers 1 and 2, or volumes I and II complete, California Fish and Game; also vol. 7, Condor, unbound.—EDMUND C. JAEGER, *Riverside College, Riverside, California.*

WANTED—Good cash prices paid for the following magazines: Audubon Magazine, vol. 2, 1889, no. 12. Auk, vol. 1, nos. 1, 2, 3; vol. 2, nos. 2, 3, 4; vol. 3, no. 4. Bull. Mich. Ornith. Club, vol. 2, nos. 3-4; vol. 3, nos. 1, 2. Bull. Nuttall Ornith. Club. vol. 1, nos. 1, 2, 3; vol. 2, nos. 3, 4. Florida Nat., vol. 1, no. 1. Hawkeye Ornith. & Ool., vol. 2, nos. 5, 6. Ind. Aud. Bull., 1920, 1923, 1925 issues. The Naturalist (Austin, Tex.), vol. 1, nos. 2, 4, 5. Oologist, vol. 5, 1888, no. 6 (original, not the reprint). Oregon Nat., vol. 1, nos. 2, 12; vol. 2, nos. 1, 2, 7.—FRED J. PIERCE, *Winthrop, Iowa.*

BOOK CATALOG READY.—The second section (Fall) of our 1948 catalog is ready for mailing and we shall be glad to send it to Cooper Club members upon request. Books on birds, mammals, wildlife conservation, reptiles, fish, trees, wild flowers, and other phases of natural history. We have a large stock of serial publications.—FRED J. PIERCE, *Winthrop, Iowa.*

FOR SALE—Mostly new uncut copies of Bent's Life Histories: No. 126 Wild Fowl, Part I, $18.00; 130 Wild Fowl, Part II, $10.00; 142 and 146 Shore Birds, both parts, newly bound in blue buckram, $16.00 for the pair, or a copy each in second-hand condition, showing some usage, $8.00 for both parts; 162 Gallinaceous Birds, a new copy, untrimmed, $15.00; 167 Birds of Prey, Part I, a fine second-hand copy, $15.00.—FRANK N. BASSETT, *722 N. Orange Drive, Los Angeles 38, California.*

FOR SALE—A file of The Auk, from vol. 13 (1896) through vol. 63 (1946), 51 volumes in all, in fine condition, in parts as issued; many of these volumes are out of print and rare; price $125.00. Also, many odd volumes from vol. 4 up, and many odd numbers as far back as vol. 9; will sell odds at a discount of 25% from regular A.O.U. prices.—W. LEE CHAMBERS, *Topanga, California.*

FOR SALE—The Nidiologist, I have the following single issues for sale to those who desire to complete their sets: 1894, vol. I, March (No. 7); vol. II, October (No. 2), December (No. 4); 1895, vol. II, January (No. 5), March (No. 7); 1896, vol. III, March (No. 7), June-July (Nos. 10 and 11), and October (vol. IV, No. 2). All are in their original covers with the exception of two issues. Make offers. —JAMES HODGES, *3132 Fair Avenue, Davenport, Iowa.*

FOR SALE—Ridgway's Birds of North and Middle America, volumes I-X (complete set); Friedmann's Birds of Kenya Colony, 2 volumes, U. S. National Museum Bulletin no. 153; Osprey, volumes 1-5 (also many duplicate numbers of the first 5 volumes).—ROBERT A. MCCABE, *Department of Wildlife Management, 424 Farm Place, Madison, Wisconsin.*

FOR SALE—A run of the Auk, vols. 44 to 64, inclusive, in numbers as issued (lacking no. 3, vol. 52), except that vols. 57-59 are bound in cloth; also Cory's Birds of Haiti and San Domingo, and Birds of Bahama Islands, in parts as issued; and Wytsman's Genera Avium, parts 1-18.—W. E. CLYDE TODD, *Carnegie Museum, Pittsburgh 13, Pennsylvania.*